United States Navy's Repair Ship "Prometheus"

By Frank A. Stanley

SYNOPSIS—The use of naval repair ships, or floating machine shops, is more of an innovation than many realize. And the scope of their activities is far greater than appears on the surface. They must not only be ready to repair any breakdown, make castings and machine them, to fit and to repair binoculars and periscopes and similar instruments, but such ships must also carry a full line of supplies, bolts, nuts, bars, plates and the hundreds of things that are likely to be called for.

The U.S.S. "Prometheus," recently arrived at New York from Mare Island navy yard, under the command of Capt. F. D. Karns, is the second repair ship to be placed in the service of our modern navy. The earlier vessel of this type was the "Vestal," which has been attached to the Atlantic squadron for the past 18 months or so and which has recently come north with the fleet upon the conclusion of the winter maneuvers at Guantanamo, Cuba.

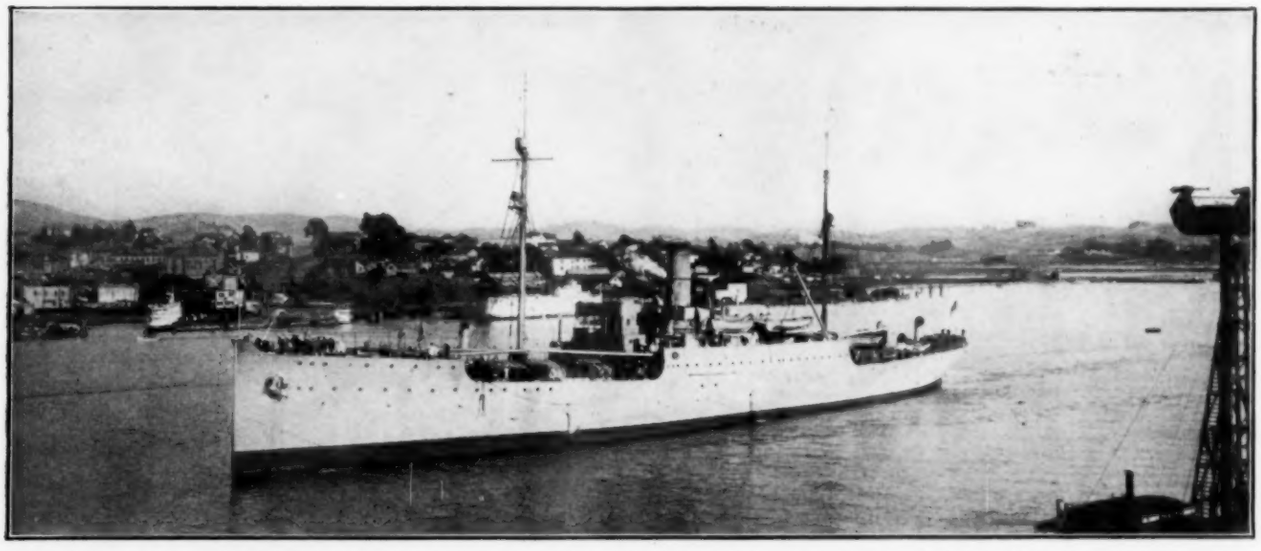


FIG. 1. U. S. REPAIR SHIP "PROMETHEUS" LEAVING MARE ISLAND NAVY YARD; VALLEJO IN BACKGROUND

It was my privilege to make the trip on the "Prometheus" as the representative of the *American Machinist*, the first time, so far as I am aware, that a technical writer has been permitted to accompany a naval vessel on a voyage of this kind. This opportunity enabled me to observe at first hand not only the equipment of the vessel, but the many activities that form a part of its duties, many of which are entirely unknown and unappreciated by those who have not actually experienced them.

The "Prometheus" sailed from California City coaling station, San Francisco Bay, on the evening of Feb. 27, with the 14,000-ton oil tanker "Maumee" in tow. Exactly five weeks later, on the evening of Apr. 2, she arrived at the Government anchorage at Tompkinsville, Staten Island, N. Y. The sailing distance over the course followed, coasting down the Pacific, passing through the Panama Canal and heading northward east of Cuba and through the Windward Passage, was 5,260 mi., the steaming time being 26 days. The stay at the Isthmus prior to steaming northward covered a period of 9 days.

The Towing Conditions

The tanker "Maumee" was recently completed at the Mare Island navy yard, with the exception of her engines. These are Diesel oil engines, which were built at the New York yard while the ship herself was under construction on the west coast. As the vessel is to serve as an oil-supply ship for the Atlantic fleet and must therefore in any case be sent around to eastern waters, it was decided to tow her to New York for the installation of her engines at this yard. With the exception of the towing of the dry dock "Dewey" to the Philippines some years ago, this is the biggest long-distance towing proposition ever undertaken. It was carried out from start to finish with complete success and in much shorter time than was generally anticipated at the outset.

For 15 days, from San Francisco Bay to Balboa, the "Prometheus" steamed steadily without stop at an average rate of about 9 knots. On the northward passage from Cristobal to New York rougher weather and adverse winds and currents made necessary a reduction in speed; but here again the 11 days' tow was accomplished with no failures on the part of any of the equipment and with only such modification in steaming rate as was necessary to assure the completion of the expedition without excessive stresses upon the towing apparatus.

The "Prometheus" had been given a complete outfit for this undertaking. The equipment included a special towing engine, a method of supporting the cable and means for measuring the strain due to the load and

varying conditions of wind and sea. These appliances are of special interest, so that no account of the voyage from San Francisco to New York would be complete without them, but they cannot be covered in this article.

Details of the "Prometheus"

The "Prometheus" was originally built as a collier at the Mare Island navy yard. She was authorized by Congress, Apr. 27, 1904, the limit of cost under the head of contract price of hull and machinery being $1,550,000. The keel was laid Oct. 18, 1907, and she was launched Dec. 5, 1908. The date of her first commission as a collier was Jan. 5, 1910. She was placed out of commission Apr. 7, 1913, and was then modified and equipped as a repair ship and placed in commission as such on Dec. 23, 1914.

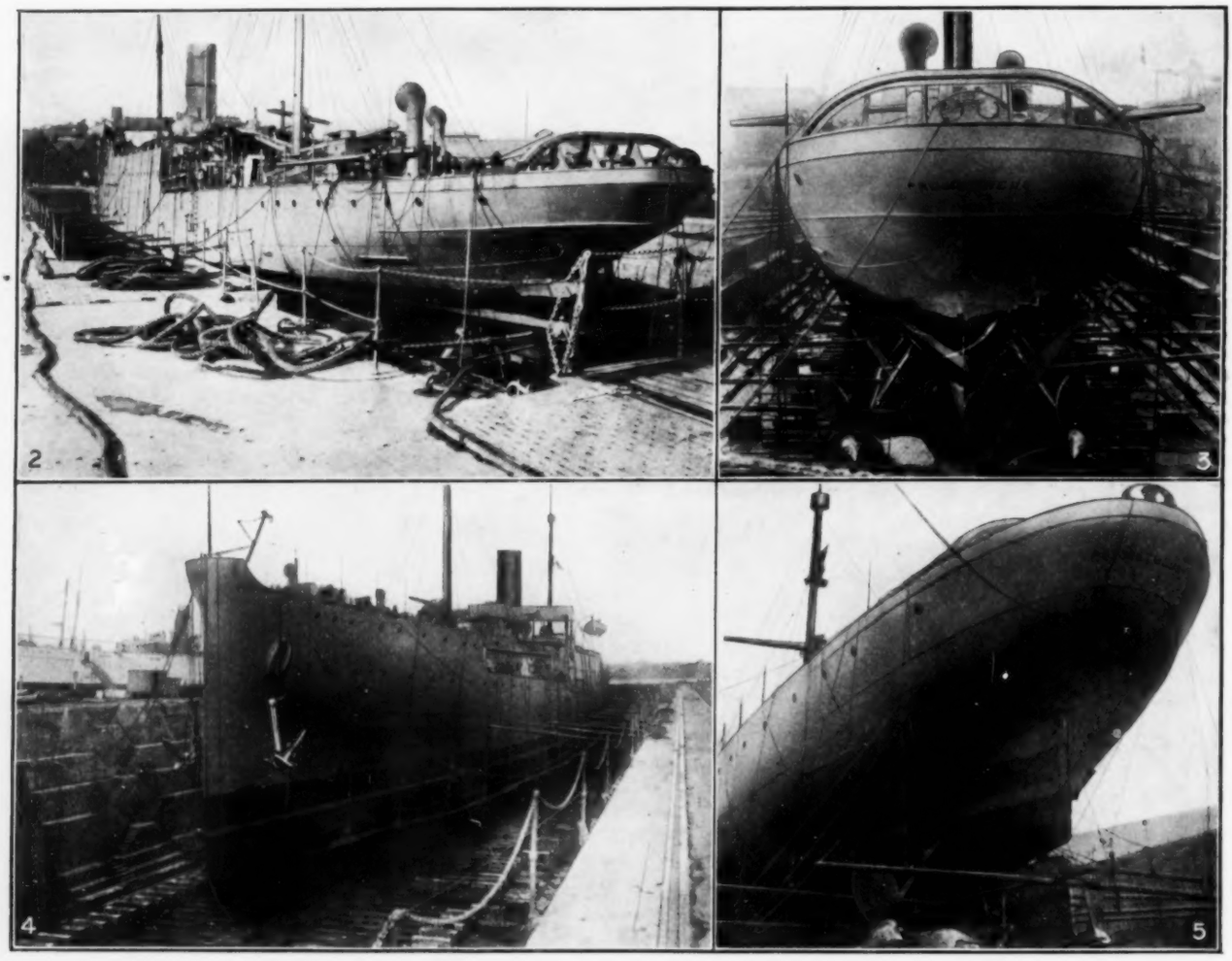
The normal displacement of the "Prometheus" is 12,585 tons; her length on designed load water line is 450 ft. and length overall, 465 ft. 10 in. Her breadth on load water line is 60 ft. and draft for repair ship, 20 ft. She is driven by two vertical triple-expansion engines with high-pressure cylinder diameter, 28 in.; intermediate cylinder, 44½ in.; low-pressure cylinder diameter, 75 in. The length of stroke is 54 in. The total maximum indicated horsepower is 7,500; the total estimated weight of machinery, 1,125 tons; the speed on trial, 16 knots.

There are six Babcock & Wilcox water-tube boilers with four doors to each furnace, a total grate service of 493 sq.ft. and total heating surface of 19,974 sq.ft. The bunker capacity, allowing 43 cu.ft. to the ton, is 1,576 tons. The generating sets are two in number.

The armament of the ship consists of four 5-in. 51-caliber rapid-fire guns, two of which are mounted on the forecastle head and two astern.

Mechanical Departments

The "Prometheus" is a floating shop with practically every department aboard that would be found in any well-organized machine-building establishment or repair shop ashore. There are a general office for the issuing of orders, the control of operations in all the mechanical departments and for keeping up the stores and issuing materials and supplies of all kinds to departments and to the men aboard; a drafting room and planning department; a general machine shop with heavy tools; gallery shops with millers and the smaller and medium-sized lathes; a toolroom for taking care of cutting tools and machinists' tools of all kinds and for issuing them to workmen on check; an optical shop; a gray-iron foundry and brass foundry; a pattern shop; woodworking shop; forge shop; boiler shop; copper shop; plumbers' shop and pipe shop. As will be noted hereafter, the equipment of each shop is quite complete.



FIGS. 2 TO 5. REPAIR SHIP "PROMETHEUS" IN DRYDOCK

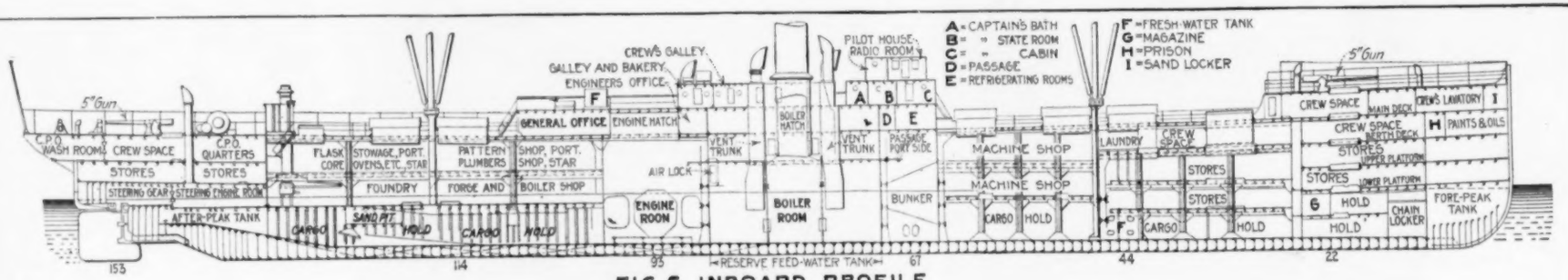


FIG. 6 INBOARD PROFILE

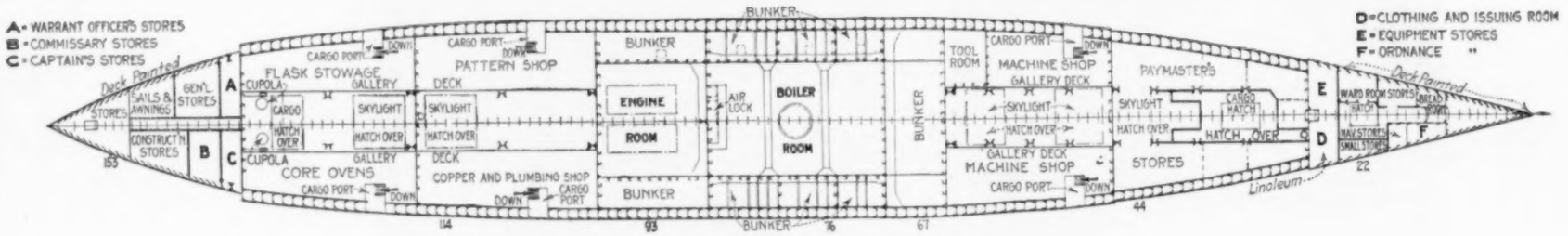
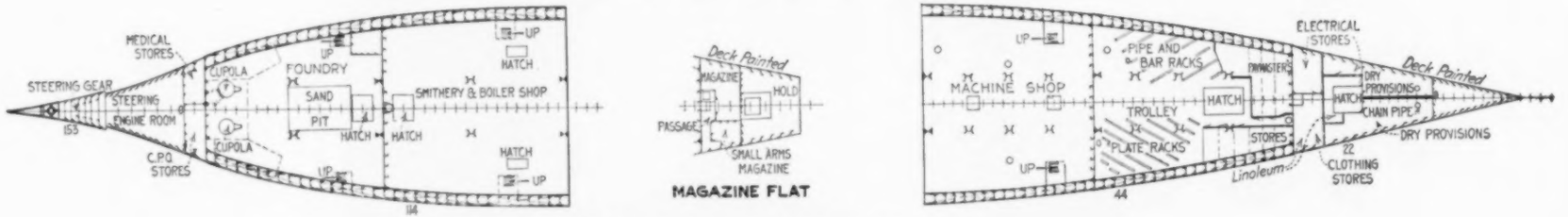


FIG. 7 UPPER PLATFORM DECK



MAGAZINE FLAT

FIG. 8 LOWER PLATFORM DECK

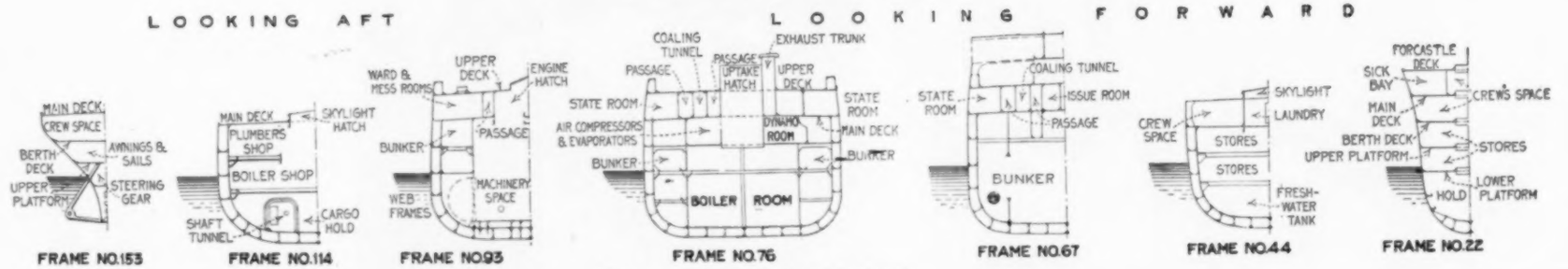
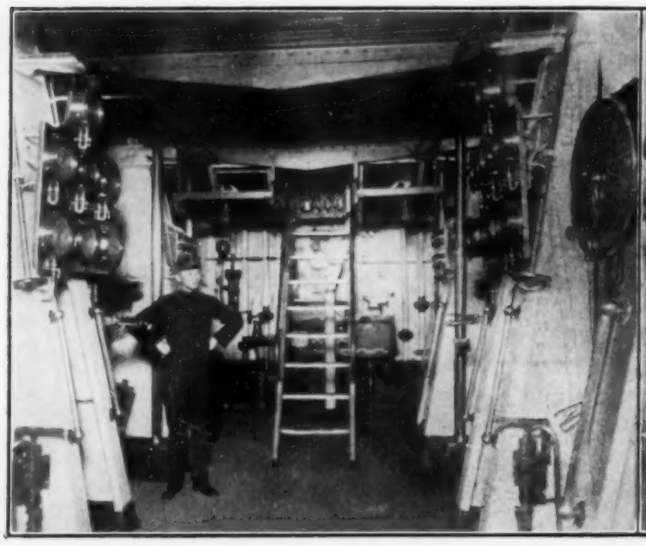


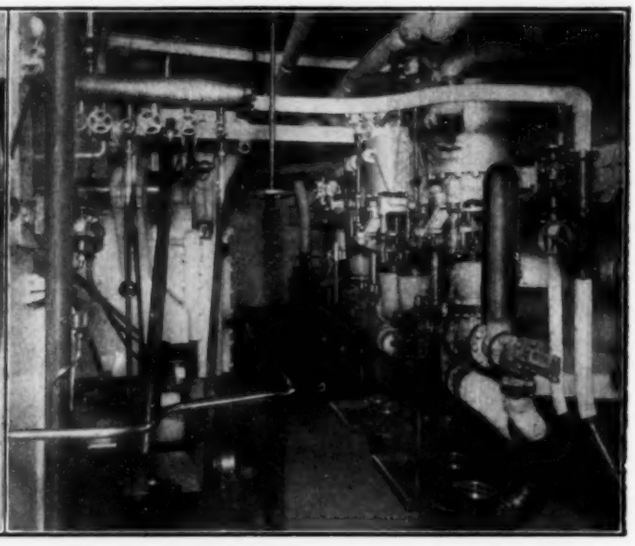
FIG. 9 CROSS SECTIONS

FIGS. 6 TO 9. PLANS AND DETAILS OF REPAIR SHIP "PROMETHEUS"

The tools in the machine shops range up to a 48x72-in. extension gap lathe, 6-ft. vertical boring and turning mill, 36-in. openside planer, 4B plain miller and so on. The forge shop and boiler shop are equipped with, among other apparatus, a 150-ton steam hydraulic forging press and with portable electric-welding machine and oxyacetylene outfit. The foundry has two gray-iron cupolas, with respective capacities of from ½ to 1 ton and from 1 to 2 tons per hour, and six crucibles—four with capacity of 110 lb. and two with 165 lb. capacity each.

It may be stated here, however, that the main machine shop has an area approximately 51x51 ft., with two galleries 16 ft. wide running the full length of the shop and with runways for a traveling crane between. The foundry is the full width of the ship and over 50 ft. in length, with a deep sand pit measuring 14x18 ft. and with an overhead traveling crane to handle flasks and work. The forge and boiler shops occupy a space practically equivalent to that devoted to the main machine shop, and the pattern shop, pipe shop and plumbers' shop are located on galleries over the forge shop, approximating closely in dimensions the galleries of the machine shop.





FIGS. 10 AND 11. ENGINE ROOM OF THE REPAIR SHIP "PROMETHEUS"

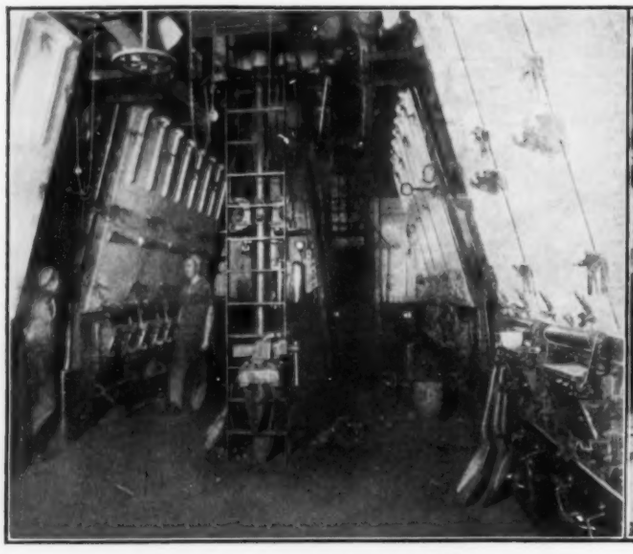


FIG. 12. PART OF FIREROOM

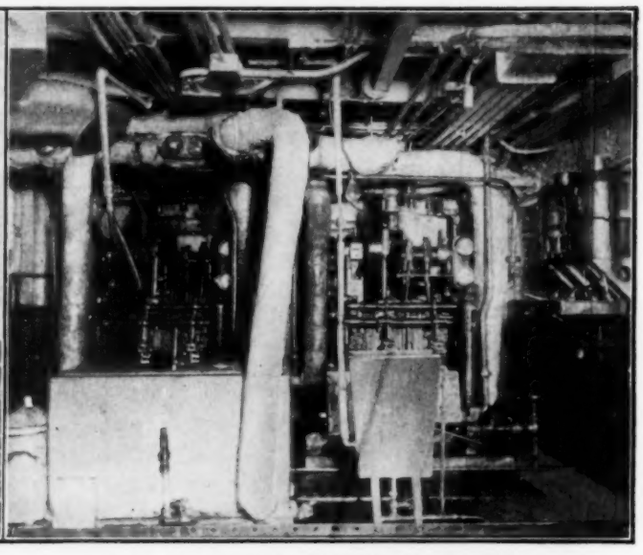


FIG. 13. REFRIGERATING EQUIPMENT

The machine-tool equipment of the "Prometheus" represents a value of over $56,000. In the pattern shop there is equipment worth nearly $6,300; in the foundry, $4,330; in the forge and boiler shops, over $8,500 worth of apparatus; in the plumbers' and copper shop, nearly $2,000 in pipe machines, pumps, rolls, shears and the like. The grand total for the machinery of the different departments exceeds $77,000. These departments, with details of the equipment and method of operation, will be illustrated in succeeding articles.

It is difficult to realize that this vessel carries as part of her regular outfit about 100 machine tools and other pieces of apparatus for wood and metal work. But in addition to maintaining a big supply of food, clothing and other articles in considerable number for a crew of several hundred officers and men there is also carried an immense quantity (six months' supply at least) of shop

and engine-room parts in the way of bolts and nuts, rivets and washers, bar material—brass, steel and iron—pipe fittings, couplings, valves and the like. Then there are toolroom stores, such as drills, reamers, taps, etc., and an almost endless variey of other articles likely to be wanted at any time when the fleet is far from port. Knowing this, it is an easy matter for one who has not seen the "Prometheus" to imagine her as a square-hulled, blunt-nosed, sluggish craft, towering deck above deck and having all the appearance of a multistoried machine shop and storehouse skidded upon a pontoon and floated ark-fashion upon the surface of the deep. As a matter of fact a preconceived notion of this character could not be farther from the truth.

Painted in the soft hues of some of the ocean liners prior to the outbreak of the European War, the "Prometheus" might easily have rivaled in grace and general neatness of outline many a well-known vessel plying between ports on opposite sides of the Atlantic. Actually, while her dark, monotonously flat surface of bluish-gray paint gives a grim-hulled inconspicuous appearance universally demanded throughout the fleets of the world, her trim lines and close resemblance to a high-class merchantman are still pronounced features. This seems all the more noteworthy when it is recalled that she was originally built as a collier.

The lines of the ship are illustrated perfectly in Figs. 1 to 5 inclusive and in the details that follow. The general view, Fig. 1, represents the "Prometheus" as she appeared in the stream between Vallejo, Calif., and Mare Island navy yard upon returning from Alaska in the fall of 1915 after visiting the various radio stations along that coast for the purpose of supplying them with needed materials, repairing their apparatus and in certain instances dismantling abandoned stations.

Figs. 2 to 5, all reproductions of photographs made of the vessel while in dry dock at Mare Island, bring out important features of construction and equipment—the fine lines of the bow and hull as a whole, the construction of the towing arch over the stern for supporting the cable, the position of the towing engine, the mounting of the four 5-in. breech-loading guns on forecastle head and stern. Incidentally these views illustrate clearly the method of docking a big ship so that the structure is properly supported by adjustable blocks placed at close intervals under the keel along the entire length of the ship, while a perpendicular position is assured by lateral shores placed between the dock walls and the hull.

Plans and Elevations

The line drawings practically explain themselves though a few words of description may not be out of place. The inboard profile, which is shown in Fig. 6, includes the shops, foundry, engine room and so on in elevation, likewise representing the space for stores and cargo. Figs. 7 and 8 are deck plans showing the officers' quarters, the locations of the mechanical departments, the machinery used on deck, including the towing engine and the arch.

The shops, foundry, pattern storage and core ovens are represented in the upper platform deck plan, Fig. 7. Fig. 8 shows the foundry and smith shop aft and the method of stowing bar and sheet stock forward. Fig. 9 gives several cross-sections which help one to understand the location of the various departments.

The ship's complement of men totals 239 and is made up as follows: Officers—commanding, 1; wardroom, 12; warrant, 4; total officers, 17; crew—seaman branch, 55; artificers, 9; artificers in engine room, 63; special, 10; commissary, 6; messmen, 11; repair force, 68; total crew, 222.

The capacity of the fuel-oil tanks, for foundry and similar use, is 35,799 gal., or 119.6 tons, while the fresh-water compartments hold a total of 39,550 gal.

Figs. 10 and 11 are views taken in the engine room, and Fig. 12 shows part of the fireroom. Fig. 13 is a view of the ice machines.

Experience in Drawing Thin White-Metal Tubes

By Herbert J. Randall

Several years ago it became necessary to draw long thin shells, or tubes, from Britannia white metal, and I was unfortunately unable to get the exact information I required at that time.

I was advised to try the extrusion method of producing tubes; but as we had only single- and double-action presses to do the work, extruding was out of the question. Since then, however, I have experimented extensively on this problem, with the result that about two years ago I obtained a shell $1\frac{3}{8}$ in. in diameter by $6\frac{3}{4}$ in. long, with a wall 0.028 in. thick. It was highly polished and secured in four operations, including the cutting of the blank.

The sketches of the dies practically explain themselves. Fig. 1 represents the cutting and first drawing dies used in a double-action press, with a blank $6\frac{1}{4}$ in. square and 0.094 in. thick. These first dies give a cup 3 in. in diameter and $2\frac{1}{2}$ in. high, but do not thin down the walls any, as the difference between the punch diameter and the die was made just twice the thickness of the blank.

During the experiments I always had good results until coming to the final operations; then the percentage of broken pieces would be anywhere between 50 to 75, sometimes more, which was anything but satisfactory. That was with the ordinary way of redrawing; but as I had spent lots of time trying to get the desired results, I thought it could do no harm to try to turn the preceding cup inside out. So I made the second- and third-operation redrawing dies on that idea, and thereafter we had practically no trouble.

The second, third and fourth dies can be used in any ordinary single-action press, provided the stroke is long enough.

The dies, Fig. 2, for the second operation brought the walls of the tube down to 0.037 in. thick and lengthened it to $3\frac{3}{4}$ in. The cup, after passing through the first-operation dies, was inverted over the die for the second operation. This die was made 0.010 in. smaller on the outside than the inside diameter of the work, to facilitate matters when feeding, as the press could be run continuously, the work dropping down through the center of the die into a box.

The third operation consists of the same operation as in the second, only the die was made to draw the work down to the required inside diameter with walls 0.034 in. thick, giving a blank $5\frac{1}{2}$ in. long. See Fig. 3.

The punch for the third operation was used on the fourth or final operation, and the die was made as in Fig. 4. This completed the work, making a cup or tube $1\frac{1}{16}$ in., inside diameter, $6\frac{3}{4}$ in. long and 0.028 in. thickness of wall, with a high polish on the outside. Of course this die had to be highly polished to get these results, and the punch was hardened, ground and lapped perfectly true, as the work after passing through this last die held tightly to the punch.

The dies for the first, second and third operations were made of machine steel and left soft but polished, and the cutting ring for the first operation was of tool steel not hardened.

The work automatically stripped itself from the punches in the first three operations, as there was a little outward spring to the top of the walls of the work. In the last-operation dies four spring fingers were placed around the die, to just let the punch through without touching. When the work was on the punch, these fingers would spring downward and over the top, thus stripping it off from the punch on the upward stroke.

The only lubricant used on these four operations was a mixture of soft-soap, soda, lard oil and water, all boiled together and left to cool before using.

The uneven ends of the work were not trued off between operations, as that was unnecessary and would only have wasted stock and shortened the final tube. The work was not annealed, or touched between operations.

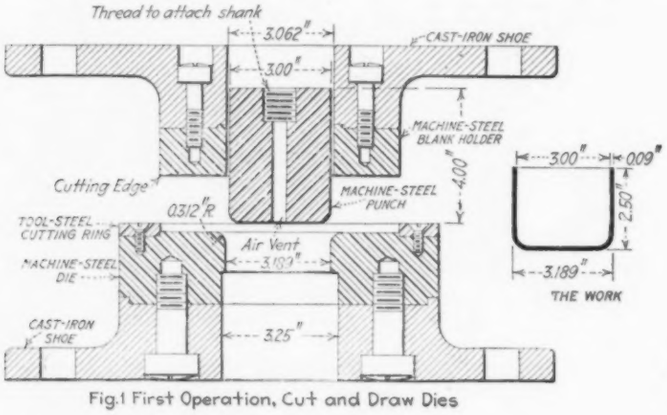


Fig.1 First Operation, Cut and Draw Dies

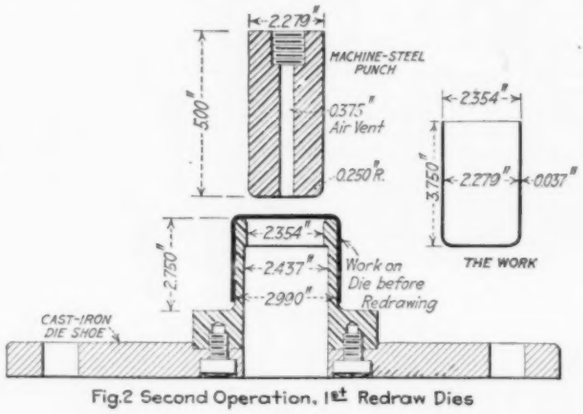


Fig.2 Second Operation, 1st Redraw Dies

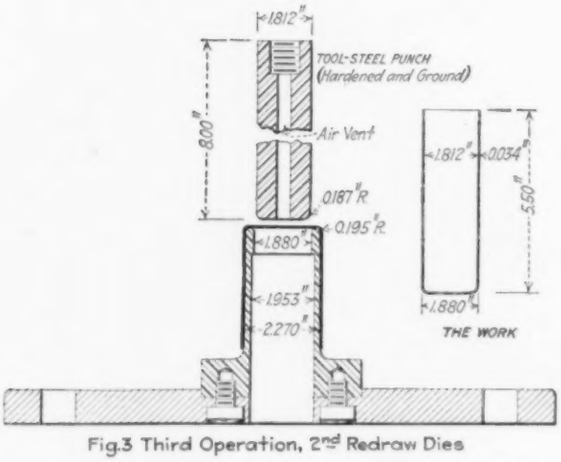


Fig.3 Third Operation, 2nd Redraw Dies

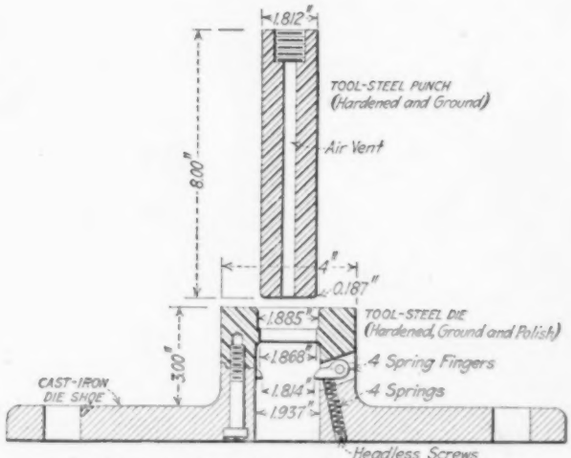


Fig.4 Fourth Operation, 3rd Redraw and Polish

DETAILS OF DIES FOR DRAWING THIN WHITE-METAL TUBES

Production of Needles, Pins and Hooks and Eyes

The production of pins of all varieties in the United States in 1914 was valued at $2,713,782. Common or toilet pins formed the principal variety, the production of which was valued at $1,248,757. These pins were made of steel and brass wire, and the quantities were reported to the United States Bureau of the Census partly in pounds and partly in packs of 3,360 and 3,600 pins each. The production of metal hairpins was 9,242,012 gross, valued at $528,362, and of safety pins, 4,744,303 gross, valued at $936,663. The output of hooks and eyes was reported as 1,076,177 great gross, valued at $1,394,745.

The production of needles in the United States, which consists almost entirely of knitting-machine and sewing-machine needles, amounted to 168,644,000 in 1914 and was valued at $1,273,084. Of this amount 94,099,000, or 55.8 per cent., were knitting-machine needles, valued at $621,784, and 74,545,000, or 44.2 per cent., sewing-machine needles, valued at $651,300. The production of hand-sewing needles was confined to three establishments, which manufactured about 90,000 needles during 1914. This production consisted largely of the small variety of hand-sewing needles, but it also included a considerable number of the large variety used for carpets, bags and other heavy work.

Noon Hour in the Small Shop

By John H. Van Deventer

SYNOPSIS—Human nature is the most important thing that the small-shop or the large-shop man has to do with. Sometimes it is densely ignorant, sometimes exceptionally bright, on some occasions guileless and again crafty. The stories related in this article are all founded on facts and illustrate these variable phases of human nature.

The millwright at the Ajax plant joined the group in front of Dave Hope's machine shop and proceeded to explore the contents of his dinner bucket. "The old woman is getting absent minded," he complained as he bit into a likely looking sandwich. "Last week she goes and puts salt into my coffee, and now here's the lift off a shoe heel in this liverwurst sandwich!"

"Better begin handing your pay envelope over and see if things don't change for the better," advised Dave.

"'T'ain't lucky," replied Billy Files; "my helper always done that and he come near killin' himself today." Naturally, after this introduction Billy had to tell what had happened to his helper.

"We had a swingin' scaffold hung from the roof truss in the main bay," related Billy Files; "and when I finished with the job, I told the durned fool to go up and take it down. It was rigged like a painters' scaffold with two sets of blocks and a single rope, so all the cuss had to do was to let himself down easy and gradual like. Instead of this he casts loose on the hitch, grabs the wrong rope and comes down like a shot. If he hadn't have fell on the old man, who was givin' Jim Hartly a rakin' over the coals, he'd have been done for sure. As it is, both of 'em are in the hospital."

Strange Things Happen Very Frequently

"A thing like that happens more often than you imagine," said Dave. "It isn't because a man don't know any better, but because he doesn't think about what he is doing. I worked in a shop one time where they built big sheet-steel fans such as they use for ventilating mines. They used to set these up with temporary bolts to see that everything went together all right and then knocked them down for shipment. One day a fellow who had been 30 years at the business was up on top to take off the scroll sheets from a 25-ft. fan. He simply sat in the middle of one of these sheets and took out the bolts one by one, forgetting that sheet iron will buckle. When he got down to the last three bolts, two on one side and one on the other, he couldn't start the nuts with his fingers, which was quite natural on account of the strain on the sheet. So he grabs a hammer and chisel, an' starts to knock the nuts off. One was as far as he got, and that was the last tap of work he did for six weeks, unless you call it work to take your medicine in a hospital."

"Aweel, it's a' the same in all countries," said Sandy MacPherson. "I was watching some ship carpenters at Vladivostok at a job of fixing shingles on a shed roof. These ship carpenters keep their tools in sma' flat trays like shoemakers' kits. The pitch of the roof was pretty steep; and when the first ship carpenter climbed the ladder and raised his tool box on the roof, off it slid with a bang. I canna say what he said, because I dinna understand Russian; but I can guess. Down he went, picked up his tools and pit them in the box, climbed the ladder agin, pit the box on the roof and pit his foot in it to hold it doon. Then he stepped off the ladder rung with his other foot. I couldn't see muckle of him as they carried him awa' on a stretcher, but the little I did see was eneuch!"

Ed Jackson Comes to the Front

Ed Jackson, the machinery salesman of the Eureka Supply Co., entered the conversation at this point. "It sometimes happens that the very fellow that you would put down for a dub pulls off some bright stunt that will make your eyes pop out. We had a case of that kind last week. A Western manufacturer who frequently does business with us wrote us a month or two ago about the possibility of collecting a bill from Judd Jenkins. It seems that he had sold Judd some $60 worth of goods at 30 days, and the 30 days were up about a year and a half ago. We wrote him that he had as much chance of shaking hands with his money again as Judd has of getting to heaven. He wanted us to collect it on a percentage, and we told him we would not undertake it for 125 per cent. You can get blood out of turnips occasionally, but you can never get money out of Judd Jenkins for goods that have been delivered; C.O.D. is the way to do business with him. They say that when he goes to church, they pass the plate before the first hymn!

"A week ago, who should show up in our office but this same Westerner who had been stuck for the $60! He was a typical boob in appearance, had a face as round and unexpressive as a washbasin, stood about 6 ft. 6 and had a pair of fists like hams.

"'What are you doing in our town, Mr. Shenkel?' inquired the boss.

"'Oh, aye vas coming East and aye stopped off to collect dat bill from dat feller Yenkins,' replied the Westerner.

"'Have you tried it yet?' inquired the boss.

"'Sure, I have, I have collected das money,' and here he pulled out a wad of bills to prove his statement.

"'How the deuce did you do that?' exclaimed the boss, 'I'd like to know your secret of collecting bills.'

"'Vell, you yust got to use diplomacy,' returned the big Swede. 'I go down py Mr. Yenkins' office one day until I see he is alone mit himself. Then I go in and say, "I'm Mr. Shenkel vat you owe $60 to and I've come for das money." He told me to go to some place what begins with "h" to get it, so I grabbed him mit one hand by der throat und shook my fist unter his nose and said, "All right, Mr. Yenkins, I'll take $60 worth of satisfaction oud of your block."'

"While the big Swede was telling us this, he was illustrating his words on me for the benefit of the boss, and I tell you if you could have felt that grip on your throat and seen the fierce expression on his face, and his big hand ready to land on your countenance, you would have realized that he was a master of diplomacy. I don't wonder that Jenkins paid up after a performance such as the Swede demonstrated!"

"I am glad to hear one of you machinery salesmen admit that you can learn something," said Dave. "Here is a tip on selling micrometers that I picked up while down in Bridgeport the other day. When a man goes to one of the big munition shops to look for a job, the first thing they ask him is if he can use micrometers. If he says no, it's all off; and if he says yes, he gets a chance to prove it. One of the progressive hardware stores in town took advantage of this to boost its sale of micrometers and started a school of micrometer reading in a back room. Every man who bought a mike was instructed free of charge how to use it. Fellows that didn't know a thousandth of an inch from an alligator before they entered the hardware store came out with a pass to a good job. That's what I call keeping up with the times!"

The machinery salesman could not remain quiet for a very long period, and it was evident that he had something to tell. "What is it, Ed?" inquired Dave. "Spit it out before it chokes you."

"I was just thinking about the plant that came near putting itself out of business," replied Ed. "You very seldom hear of a plant being its own competitor, but this case I have in mind was just such a one. They made high-grade edge tools, such as carpenters' chisels, and were very strict about the quality of their goods—something that you can't say about all of the shops in that line of business. When a blade wouldn't come up to the test, out it went regardless of expense. Probably one-third of their total output went to the scrap heap because its quality was not up to their standard. After a while the manager of this company began to find himself up against a rather strict competition in which goods similar to his, but with slightly inferior quality, were being sold at one-half the price. He could not see how it was done, knowing that even allowing for the inferior quality these goods must have cost more than they were selling for. Finally he employed a detective agency to try and trace a source of supply, but was a surprised man when this source proved to be his own scrap pile! The foxie junk dealer who had been buying this scrap for several years had made extensive preparations for just such a coup. Nowadays this is more or less a matter of history, but I notice that the edge-tool companies are particular to break their scrap into small pieces before it gets outdoors."

Painting the Backbone on a Belt

"That concern was almost too conscientious about the quality of its goods, which is more than can be said for some of you salesmen," said Dave Hope. "Old man Ruggles was in the market some time ago for a main-drive belt for his power house. The order went to a good reliable belting concern, and one of the salesmen for a less reliable house began to knock. You know how Ruggles is, and how suspicious he is of everybody. This bright Alex told him that the big belt factories employ artists to paint the backbone on a piece of belt so that it will look like center stock and that all he was likely to get when he got his belt in was a piece of side hide, but that he could make sure of the matter by scraping on the backbone when the belt was received. If the mark came off, that would prove that it was a fake job and had been painted on there.

"Ruggles could hardly wait to get hold of the big belt to make this test, for he was afraid of anyone putting anything over on him. So when the belt came in, he got out his scraper and began to scrape; and naturally enough the mark came off. He jumped for the telephone to call up the belting company. 'Say, you big fakers,' said he, 'send your wagon down right away and take away that fake belt you sent me.'

"'What are you talking about?' came from the other end of the line.

"'That big belt I bought has the backbone painted on it to make out it was center stock,' replied Ruggles. 'I scraped off the mark that your painter put there.'

"The manager of the belting concern was probably too much astonished to reply. When Ruggles found out later how the salesman had misled him into making a fool of himself, however, he declared he would spend the rest of his life in getting even, and I expect that he will."

Just at this point the whistle blew, and the small-shop noon hour was over.

A Neat Bolt Storage

Much of the value of having a good supply of bolts is in being able to find them when wanted. The illustration shows the excellent system adopted by the Atchison,

SANTA FE SYSTEM OF BOLT STORAGE

Topeka & Santa Fe Ry. at Arkansas City, Kan. The bolts are neatly stacked and labeled, as can be seen, making it easy to select the size wanted and to know how many are in stock.

Machining Cone Pulleys on a Drilling Machine

To run right, a cone pulley must be machined both inside and out, especially if it is to run at any speed. On the drilling machines made by the F. W. Lindgren Co., Rockford, Ill., the cone pulleys are machined all over. Most of this work is done in a drilling machine fitted with special chuck and tools.

The tools for machining the inside of the pulleys are illustrated in Fig. 1. The pulleys are in five steps, 1⅜ in. wide, the smallest step being 2 in. in diameter. The pulley to be machined is placed in the spindle chuck, as at *A*, and held in by setscrews. It is then brought down over the cone tool, and the cutters at *B* and *C* machine the inside of the steps, the outside of the center and partly clean up the small end, leaving the inside as at *D*.

The chuck to hold the cone is removed in Fig. 2, in order to show the inside. The place where the small step of the cone goes in is taper-bored, so as to act like a self-centering device. The rest of the cone is centered so as to run approximately true by means of the two sets of set-screws conveniently located for tightening and releasing.

used to drill two driver holes at *D*. In actual use, a steady-bracket *E*, Fig. 4, is used close down to the tool block, but this was omitted in the previous illustrations in order to show the parts better.

The outside of the cone is turned as in Fig. 5, which shows the cuts finished and the tools just being drawn

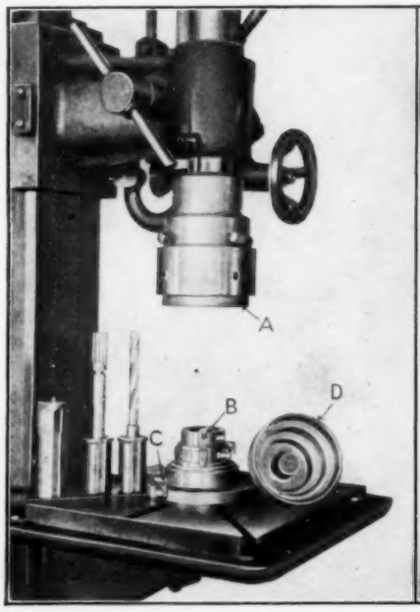


FIG. 1. BORING THE INSIDE

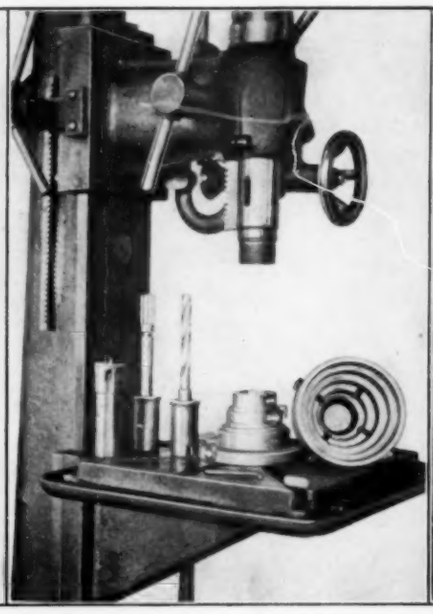


FIG. 2. SHOWING INSIDE OF CHUCK

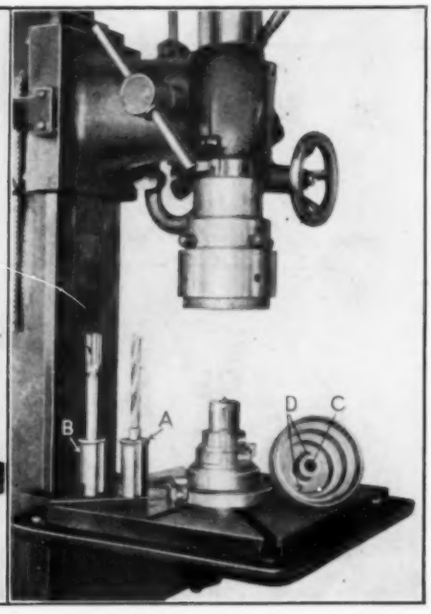


FIG. 3. CENTERING TOOL IN PLACE

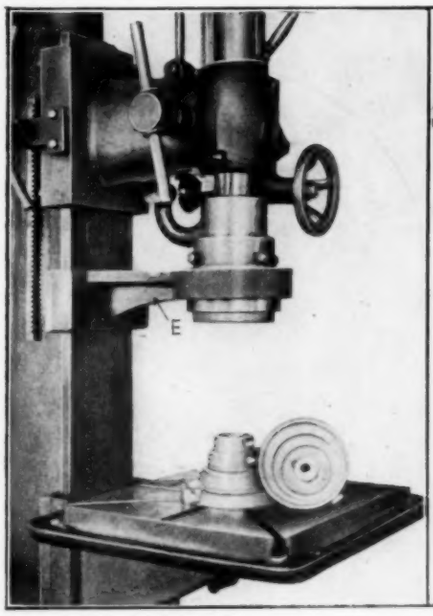


FIG. 4. THE STEADY-BRACKET USED

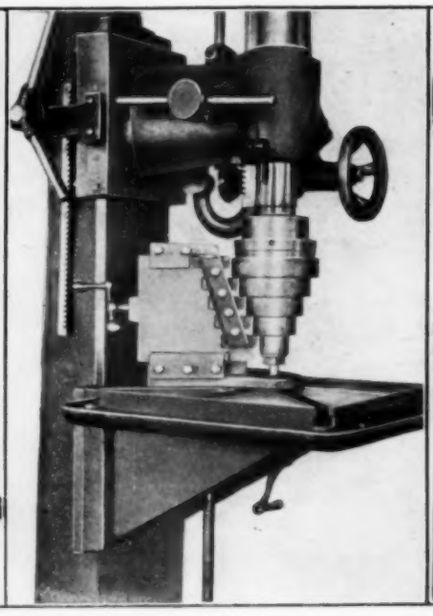


FIG. 5. TURNING THE OUTSIDE

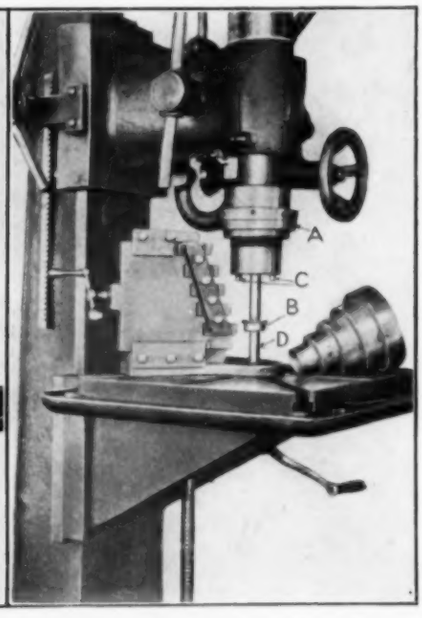


FIG. 6. DETAILS OF WORK HOLDER

After the inside has been machined out, a center drill is placed in the tool block, Fig. 3. As can be seen, the center drill is held in a holder having a keyway on one side. The holder fits in the bore of the tool block, over a key that keeps it from turning. This tool not only carries a center drill, but also a tool for finishing the end of the pulley center. Next, the center-drill holder is removed, the twist-drill holder *A* is put in, and the center, or spindle, hole is drilled. This is followed by reamer *B*, leaving the work as at *C*. A simple jig is next

back. The tools are fed by means of a ball crank. The cone is shown removed in Fig. 6. It will be seen that the part *A* of the holding fixture is beveled so as to receive and center the large end of the cone. The pilot spindle fits the spindle hole of the cone, and the piece is held on by the nut *B*. The pulley is kept from slipping by means of the two driver pins *C*, which enter the two holes previously referred to. The lower end of the pilot *D* fits a bushing in the table bracket and steadies the work during the cut.

Lathe Fixtures Used for Machining Textile Machinery Parts

By Robert Mawson

SYNOPSIS—In this article are shown fixtures used on lathes in manufacturing parts for textile machines. Some of these tools have a taper shank to fit inside the spindle of the machine. Others are supplied with an arbor supported on the centers of the lathe. All are simple in design and construction, yet are producing good results.

Scott & Williams, Inc., Laconia, N. H., manufacture a variety of textile machines. Some of the tools used in machining the parts of hosiery machines were shown on page 1020, Vol. 44. This article describes fixtures employed on lathes for machining other textile-machine parts. By their use the parts are produced on an economical and interchangeable basis. The locating devices are rapid in action and, as will be noted, simple in design.

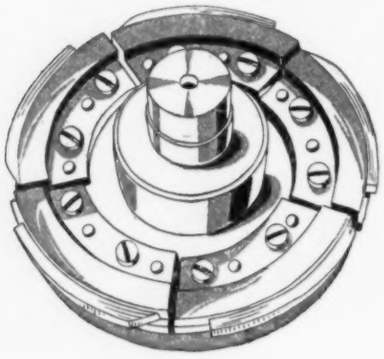


FIG. 2

FIG. 4

FIG. 6

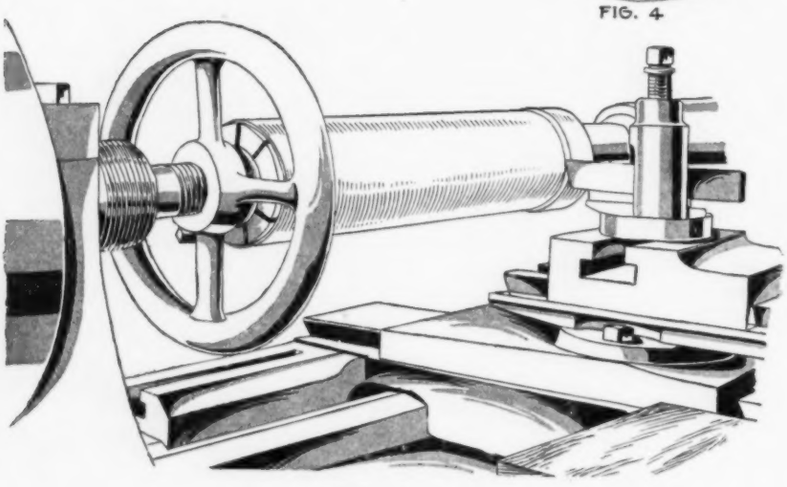


FIG. 8

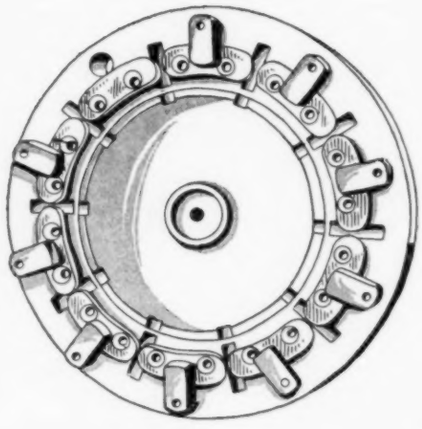


FIG. 10

TURRET-LATHE FIXTURES FOR TEXTILE-MACHINERY PARTS

FIGS. 2 AND 2-A

Operation—Machining the outer periphery of drum cam, Fig. 1. The castings are located against shoulders on the inside of the five plates shown. The fillister-head screws are then tightened down on the plates and hold the parts in place.

FIGS. 4 AND 4-A

Operation—Machining the inside circular contour on the center post cam, Fig. 3. The steel strips are slid in from the end of the fixture into a turned recess. The headless set-screws in the outside flange, being tightened against the elements, force and hold them securely in the fixture.

FIGS. 6 AND 6-A

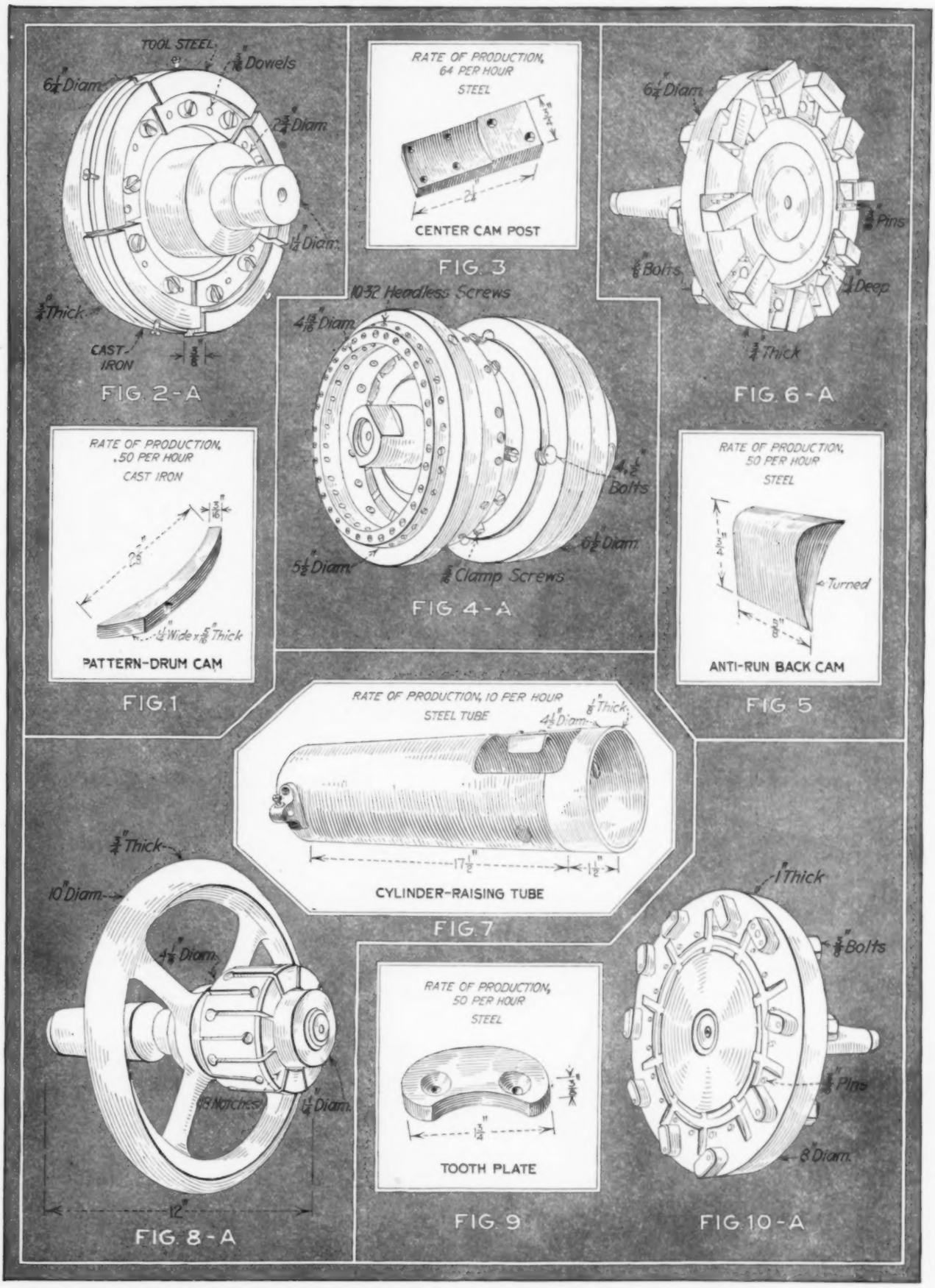
Operation—Machining the circular form on the inner edge of the anti-run-back cam, Fig. 5. The steel elements, which have been cut to length, are placed in the various slots and located against dowel pins. The hooks on the bolts are then swung over the parts being machined and the nuts, being tightened, hold them securely.

FIGS. 8 AND 8-A

Operation—Machining the outside of the cylinder-raising tube, Fig. 7. The casting is held by an expanding arbor, which fits inside one end of the tube. By revolving the large handwheel shown the arbor is expanded against the tube. The other end of the tube is carried on a center in the tail-stock.

FIGS. 10 AND 10-A

Operation—Machining inside of tooth plates, Fig. 9. The pieces are located on dowels that fit into previously drilled holes. The hook bolts, being tightened against the parts to be machined, hold them in position.



DETAILS OF LATHE FIXTURES USED IN MACHINING TEXTILE-MACHINERY PARTS

Heating Factory Departments*

By W. Rockwood Conover†

Heating factory departments in plants located within the zones subject to low temperatures and frequent climatic changes is one of the difficult problems the manufacturer has to meet. It involves not only a large yearly expenditure for fuel, but also a more or less large outlay of labor and material for maintenance and supervision. It is essential that proper temperatures be maintained in the shops, as otherwise the productive efficiency of the working forces is reduced and mechanical processes are interfered with. It is necessary for the steam plant to be prepared at all times for high peaks of consumption and sudden fluctuation of loads.

All manufacturers are largely conversant with the advantages of the vacuum system for quick heating of shop radiators and coils. This system is far more rapid in action than the old gravity system. The relief of the back pressure on engines which may run from 1 to 3 lb., however, is a more important factor in giving this system a decided advantage over either the gravity or vapor system. The cost of installation is somewhat increased on account of the initial outlay for pumps and valves, but the cost of return piping is relatively equal. The gain in economy and efficiency is a factor meriting consideration when new plants or additional buildings are being projected.

The problem of economical heating and uniform temperatures is a most difficult one. In spite of efforts at control, some departments will be overheated, while in others the temperature is often below the point of health and comfort for employees. Scarcely any two buildings will remain at the same temperature, with equal radiating surface and equal pressure, and the superintendent in charge will frequently find on his round of inspection that much of the heat produced is going to waste. The foreman in a busy department has little time to devote to this subject, and his attention is constantly distracted by other matters. In consequence the windows are thrown open by the workmen and the resultant loss of heat is large. Departments where the nature of the work compels constant, active physical exertion on the part of the employees require a lower temperature than those in which the employees sit at benches, doing light manual labor only. It is obviously important that some competent assistant be delegated to regulate the steam supply to suit requirements, both from a point of economy and for the comfort of the workmen.

Steam-Flow Meters and Supply Valves

Steam-flow meters should be installed on all mains entering the several shops for the purpose of obtaining data on the flow of steam to each department, whether the supply is used for heating or for manufacturing. These instruments are an efficient aid in regulating consumption and checking waste.

During the operating hours of the day the temperature in shops should be regulated by means of the supply valves to radiators and coils, and not by the opening and closing of doors or windows, thus permitting the continued consumption of steam when it is not required. The main gate valves and the vacuum valves on the return lines should not be interfered with by employees in endeavoring to regulate temperatures. Care should be taken to cut off the flow of steam at the close of the day from all places not requiring a supply throughout the night. Steam-heating apparatus of various kinds—ovens, tanks, dipping vats, etc.—are often sources of loss because of the connecting valves being left open by the careless operative when leaving the department for the night. These valves and all doors and windows should be closed at quitting time in order to prevent loss and damage from freezing temperatures.

All space about the radiators and coils should be kept open and free, so as to secure the fullest degree of radiation. The careless practice of allowing productive materials, rubbish and inflammable matter of various kinds to accumulate about steam pipes and steam coils during the months when there is no pressure prevails in most factories throughout the country. Such materials not only prevent proper radiation from the pipes and coils, but increase the fire hazard to a very great degree. It is essential that a thorough inspection of all departments be made each year before the fall or winter load is turned into the shops.

Building repairs which have been postponed or neglected during the summer months should be completed before cold weather sets in. No amount of steam pressure will properly heat a department with broken windows and with doors which will not close. The cold drafts, when zero temperatures prevail, will neutralize the greater percentage of heat generated; and besides the loss incurred, much discomfort is forced upon the employees, whose energy and efficiency are thereby decreased. The false economy of such neglect is evident to every thinking manufacturer. Were it not for the fact that such conditions exist to a large extent in nearly every manufacturing center in the country, a reference to the subject would be superfluous.

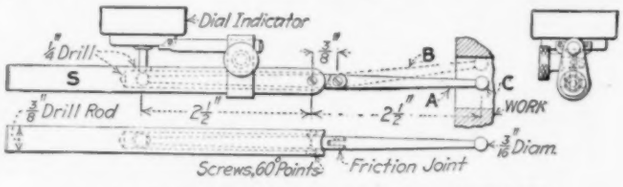
*Prepared for the author's forthcoming book on "Industrial Economics." Copyright, 1916, Hill Publishing Co.

†Factory economist, General Electric Co.

Indicator for the Miller

By Charles A. Free

This attachment was designed for service in the miller spindle in setting holes (which have previously been bored) in line with the spindle. It is held by the shank *S* in a collet or chuck, with the point *C* in the position



INDICATOR ATTACHMENT FOR THE MILLER

A. The hole can be set approximately in line by eye before moving *C* into position *B* and employing the dial indicator.

With this attachment a dial indicator can be used in very close quarters, such as holes near projections, and in recesses that cannot be reached with any device now on the market.

In a great many cases, such as making a duplicate of a jig, the original can be put behind the duplicate on the miller table. If the holes to be bored are cored or rough-drilled, one can reach through them and indicate the holes in the original.

Japanning in Tumbling Barrels

By T. P. Archer

SYNOPSIS—Small articles of metal are now being made in such unlimited quantities and varieties that the necessity for a low-cost, efficient method of obtaining a satisfactory finish has become of paramount importance. The adoption of the tumbling barrel for japanning and in some cases for enameling and lacquering has solved this problem in a way that amounts to little less than a revolution of former methods, and an astonishing degree of economy, efficiency and quality has been attained.

Successful application of the tumbling process is almost necessarily confined to the small-wares field. Such articles as eyelets, buckles, buttons, clasps, knobs, hooks and eyes, springs, snap fasteners and innumerable small articles of trunk, furniture and general hardware are by this method rapidly and satisfactorily finished. The results obtained are in many instances an improvement over the older methods of dipping and brushing.

The process of coating goods with japan in the tumbling barrel is quite simple once the elementary principles involved are thoroughly understood. A quantity of work is placed in a tumbling barrel, preferably of the oblique or tilting type. The required amount of japan is introduced into the barrel either before or after the work has been put in. Some classes of work require very light coatings, and at times it is advisable to paint the japan on the sides of the barrel. This is not often the case, and ordinarily it can be introduced in any convenient manner.

Apparatus Necessary for Japanning Shop

Briefly, the apparatus required is, first, the tumbling barrel; second, trays or pans into which the work is dumped from the tumbling barrel when the coating is complete; and, third, the oven in which the finish is completed by the usual baking process.

Supplementary equipment consists of japan mixers, measures for both work and japan, dairy thermometers, a hydrometer graduated for liquids lighter than water, trucks to facilitate the handling of the trays between the oven and the tumbling barrels and adequate methods of temperature registration in the oven itself.

Of primary consideration in this apparatus are the tumbling machine and barrel, which must be carefully designed to fit the work and to conform with the handling methods both before and after tumbling, if the process is to be efficiently and economically handled.

Some japanning can be done in almost any sort of apparatus that will revolve. The writer is acquainted with an outfit (now peacefully reaping the reward of long and faithful service in a corner of the factory attic) the chief component of which was an old gasoline can from which the top had been removed. And history has it that the predecessor of the old gas can was a 10-lb. lard pail.

Satisfactory results in the present stage of manufacturing advancement cannot be obtained in a lard bucket, and the expenditure of a little time, thought and money in designing proper apparatus in the beginning will prevent many little profit leaks later on.

Barrels suitable for japanning are manufactured by several concerns in the United States. As a general rule each manufacturer makes only one size, and it is only infrequently that this is properly proportioned to the work in hand. Barrel size has a considerable effect on the efficiency of this type of finishing, and the fact that manufacturers are making such a limited line is largely due to lack of real knowledge of the underlying principles governing tumbling-barrel japanning.

Size of Tumbling Barrels Is Important

In making a recent installation it was found advisable to use three different sizes of barrels, none of which could be had in the open market. The difficulty was overcome by purchasing tilting-type tumbling machines without barrels and having a local tinsmith make the barrels of the size desired. Thanks to the manufacturer who did not care to take the trouble to make up special sizes, a saving of more than $10 per barrel was obtained.

As these barrels were for light work, they were made out of No. 14 gage galvanized iron. The bottom was double, one piece being flanged over of a size that would fit the outside of the barrel sides and the other so flanged as to fit the inside. Rivets through both flanges and the base of the barrel sides made a tight and substantial job. Four ribs out of ¾-in. angle iron were provided to assist the tumbling of light work. After a preliminary grinding out with sand and water to get a smooth inner surface the barrels were put to work with satisfying results.

Barrels can be made of any material that will smooth up. Some manufacturers claim that brass is the only satisfactory material for such use, but this is an expensively erroneous idea. Both galvanized and planished iron are being used in many installations with excellent results.

Generally speaking, the barrel should be of the tilting type. Even where it is not advisable to use the tilting feature for discharging the barrel, it is advantageous, as the angle of the barrel can then be varied to get the best results out of work of various sizes and weights. The lighter the work the nearer horizontal, within rather wide limits, will the barrel have to be pitched. Heavy work tumbles well with the barrel comparatively high.

The barrel should be wider at the mouth than at the base and for convenience should not be much deeper than the width of the mouth. An excellent proportion of dimensions is 20-in. diameter of base, 24-in. diameter of mouth and 24- or 26-in. depth. This, for light work, provides an opening that will accommodate a tray of considerable width and the extreme of spreading surface and "evaporative plane"—more along this line later on.

Work Should Be Divided Into Lots

Tumbled work should in the beginning be divided into lots of definite and unvarying size. These individual lots should be kept distinct throughout the various coatings and dryings that go to make up the complete process. They should never be mixed with other lots, even of the same coating, if the best results are to be obtained.

The size of the lots should be determined by but one thing—the quantity that can be most efficiently and

economically handled. It is at this point that barrel size and design and the size and design of the trays or pans into which the work is to be dumped for baking should be carefully studied. Size of the individual articles enters into the problem to some extent, as very small or very weighty articles cannot be handled economically in as large quantities as light, bulky parts.

The lot should be as large as can be handled in a single tray, which should be as big as a man can satisfactorily move about without excessive labor or danger of spilling. The barrel should be of a size that will give the widest tumbling surface possible to a single lot. The barrels can be too large, but the writer has never seen such; they are generally ridiculously small. It really is an amusing sight to see a full-grown man racing around before a half-dozen thimble-sized tumbling barrels, measuring, charging and discharging, when two barrels of the proper size would do the same amount of work in less time and require considerably less labor.

An important point in tray design is to have the tray of such size that the contents can be dumped directly into the barrel for subsequent coatings without any intermediate dumpings into buckets or baskets. If the barrel mouth is small, the tray width must be reduced; and it is very easy to carry this to a point where handling becomes excessive.

On Light Work More Than One Tray Necessary

It is at times economical, where very light work is being handled, to use two or three trays to a single tumbling lot. Work cannot then be dumped from the barrel to any advantage and must be scooped out into the trays. If this is done with a specially prepared scoop, one or two loadings of which will exactly fill a tray, emptying the barrel is rapidly accomplished; and the time saved in the tumbling easily overcomes the little addition to the handling time.

Trays are made in various forms. They generally have a wire-cloth bottom, and the sides are constructed as lightly as possible to insure rigidity. The possible depth varies with the size of the work. Large work can be baked satisfactorily if quite deep, while buttons, eyelets, tags and small close-lying parts should not be deeper than 1½ or 2 in. to get good results in the oven. Some manufacturers spread their work much thinner than this; but if the oven facilities are right, a little depth does no harm.

Actual application of japan in the tumbling barrel is accomplished through the rubbing contact induced by the tumbling process. When work is introduced into a barrel and the barrel revolved, the tendency of the work is to climb up on the side away from which the top of the barrel is turning. When the work reaches a point where gravity overcomes centrifugal force, the pieces at the top fall of their own weight, sliding down the mass. It is this sliding that produces the rubbing and causes the spreading of the finish that is being applied. Therefore (and this is a point many japanners miss in using the tumbling barrel) only the surface of the mass is in actual, efficient, rubbing contact.

An important adjunct of rapid tumbling is rapid evaporation of the volatile thinner in the japan. This thinner is the medium whereby a rapid spreading of an even coat is accomplished. Tumbling is not complete when a mere even coating is obtained, but must be continued until the thinner has evaporated to a point where the japan becomes "tacky" and will not flow after tumbling has stopped, thus causing "runs" or thick and thin spots.

The larger the barrel, therefore, the larger the tumbling or sliding surface, the greater the evaporative plane and the more rapidly the work can be finished. It is a curious fact that two buckets of parts rolling in a barrel just large enough for two buckets will take nearly as long to finish as four buckets rolling in a larger barrel, provided the tumbling speed is the same.

Speed of the Tumbling Barrel a Factor

By "tumbling speed" the number of revolutions per minute is not meant, but the actual speed of the sliding mass of work. This is determined by the barrel's peripheral speed, which should be the same in all sizes of barrels for the same class of work.

The highest peripheral speed that will keep the work rolling and not cause "following around" through the action of centrifugal force is generally the best. Sometimes it appears that too high rolling speed causes too rapid evaporation; that is to say, the work becomes tacky before sufficient spreading has taken place. Frequently this is the result of too little japan being used or of an improper mixture.

For medium-weight work a peripheral speed of about 200 ft. per min. will be found to give very satisfactory results. For lighter work, such as thin cups, small eyelets or tin tags, this may prove too fast. For heavier work or more bulky articles a faster speed can be selected.

The exact amount of tumbling required for various articles must be very carefully determined. It will vary with the temperature of the room in which the work is being done and with the number or kind of coats the work may have had previously. For this reason it is highly important that the amount of work per lot should be exact and the quantity of japan introduced with each lot the same. The quantity of japan may also be varied by the number of previous coats the work may have received. In other words, if the work quantity is exact and the amount of japan introduced for each particular coat the same, the tumbling time will be the same except for the slight variation which may be caused by the temperature of the surrounding atmosphere, which must be carefully regulated. In summer, when it is not practicable to cool the room to the temperature maintained through the winter months, it will be found necessary to reduce the tumbling times, particularly on the finishing coats.

Too much tumbling will leave the work dull and lifeless. Too little will result in improper spreading or, after baking, the work will appear mottled, the articles will cling tightly together and upon being broken apart will show a white spot at the point of cleavage. If the tumbling is properly done, spotting can be entirely eradicated if the work is allowed to air-dry for a few hours after tumbling and is loosened by shaking just before being placed in the oven. After baking, the work will be as loose as so many dried peas and show no blemishes.

Suitable Japan Obtained by Experiment

Such an enormous variety of japans at such a diversity of prices are on the American market that it is hard for the uninitiated to choose between the salesman who has a good product and the one who only says he has. Few japan salesmen know anything whatever about japanning, and to the purchaser experimentation seems the only road.

For tumbling work a heavy-bodied varnish is generally required, especially for the finishing coat or coats. During the last few years many manufacturers have found it economical to use a primer coat of comparatively cheap japan, having little varnish in the body, but largely made up of an asphaltum base which gives a heavy body, runs on smoothly and provides an excellent surface for the finish coats. A prime requisite is that the japan must bake hard and cling close to the metal being treated; otherwise, it will either flake off or rub thin at the edges, and brown spots will appear.

Three coats are generally necessary to obtain a perfect finish by the tumbling-barrel method. Two coats are being used successfully, but in some instances where very thin coats must be applied as many as four or five coats are required.

The most important item for consideration in relation to japan is that of mixture. The japans now manufactured are entirely too thick for tumbling-barrel use; that is, their viscosity is such that they will not flow with sufficient readiness to give a perfect coating. Thinners are therefore used to bring them up to a consistency that will attain the best results. A proper mixture will give good results frequently under the most unfavorable circumstances. An improper mixture can never give the best results and often is the cause of downright failure. But the mere mixing of a certain quantity of thinner with a certain quantity of japan will not insure uniformity of the resultant mixtures, nor will this method alone be found continually satisfactory.

Use of Thinners in the Japan

Thinners generally used are naphtha, benzine, turpentine or any of the patented or trade-marked offerings, which usually have naphtha or benzine as a base. For tumbling-barrel work the writer prefers naphtha or benzine. Either of these is generally cheaper in first cost, provides a smooth, even-spreading medium, evaporates rapidly and does not cause such heavy fumes in the japanning oven. These vapors, in cases of poor circulation, are the causes of charring and discoloration.

Temperature enters into the proper mixture of japan and thinners to a surprising degree. Not only should both the japan and the thinner be of a uniform temperature at the time the mixture is made, but the mixing process should always take place at the same temperature, so far as possible. A satisfactory temperature for this purpose is 70 deg. F., as this can be attained most easily both summer and winter.

Uniform consistency of the mixture, which alone insures uniform spreading of the coating, can only be had through maintaining a uniform specific gravity of the mixture at a given temperature. The writer has found that, if both japan and thinner are kept continually above 66 deg. F., an even mixture can be maintained, provided only small lots are mixed at a time, without recourse to the hydrometer. But if japans and thinners are mixed at uneven temperatures or at temperatures below 66 deg. F., uncertain results are almost bound to occur. For particular work the hydrometer can scarcely be left out of the equipment.

For light coatings on light work the mixture should show a specific gravity in the vicinity of 43 deg. Bé. For heavier coatings or heavier work a lower specific gravity can be satisfactorily used. This must be determined by experiment, but the important feature is that after this is once determined, if uniform results are to be insured, it must be consistently maintained.

Mixing can be done in large quantities with satisfaction, provided some means for stirring and frequent testing with the hydrometer are provided. A common cedar churn with a revolving dasher and holding about 6 gal. has been found satisfactory for small installations. It should be equipped with a funnel in the top and with a molasses gate for drawing off the mixture. If different grades of japan are used, several churns will be required, as the grades cannot be mixed to any advantage. And if the cheaper grades get mixed with the better finishes — well, the japanner might as well prepare the little speech he will soon have to deliver in the office.

Baking of tumbled work involves two features that must be carefully watched. The first is uniformity of temperature and circulation within the oven, and the second is thoroughness of bake.

Tumbled work generally consists of small close-lying parts. When loaded into trays that are usually not very widely separated, this work forms a comparatively heavy mass through which it takes a considerable time for heat to penetrate. Japan gives off heavy fumes, and the greater the japanned surface the more fumes there are. If they are not pretty well cleared out of the oven, discoloration and charring frequently occur. On the other hand, if they are cleared out too rapidly, drafts are set up which result in rapid heating in some portions and slow heating or underheating in others.

The writer has observed ovens that had an interior variation of 300 deg. F. during the progress of a bake. Under such conditions uniform results are virtually impossible if anything like particular work is being done.

Too high a temperature causes cracking of the finished work. And here is a little kink for japanners using more than three-coat work: First- and even second-coat work can at times be baked at a too high temperature without visible damage, particularly if asphaltum-base primers are used. But when a third coat is put on, if it is a heavy varnish japan, a cracked finish may result even if the baking temperature is not carried beyond the danger point. The only safe way is to see that circulation and temperature range are uniform. This condition can easily be assured with the sensible application of the proper heat-measuring instruments.

If japan is not baked at a sufficiently high temperature or long enough, the coating will be soft and will, when a subsequent coating is applied in the tumbling barrel, rub off. The work will then appear brown or worn at the edges and corners where the greatest rubbing occurs.

Japan can scarcely be baked too long. As it can be baked at a too high temperature or not long enough, the economical baking time must be arrived at by using the highest temperature possible with the given japan and for as short time as will insure a hard lustrous cost.

Various japans require various baking temperatures. Some will not permit a higher temperature than 350 deg. F. without cracking. Some will withstand a heat as high as 550 deg. Ordinarily, it is advisable to use the higher-temperature japans for tumbling work, as those finishing at lower temperatures do not get as hard as the higher-heat japans nor do they wear as long. Their chief claim to recognition is that their first cost is a little less.

Generally speaking, a temperature in the neighborhood of 425 deg. F. is a good baking temperature for this class of work. If your japan will not withstand this heat and is not wearing well at the lower heats, get a better grade of japan. If it is wearing well and is still cracking at low temperatures, examine your heat-registering instruments. The frequency with which these are found inaccurate or inadequate is really astonishing. So much depends on proper temperatures, properly registered, that it will pay many times over to see that the instruments are, and remain, dependable.

Comparative Quality of Oil

By G. A. Smith

The consumer always wishes to purchase the best oil for the least money, and the quality of a certain grade of oil being undeterminable to the eye, resort is had to practical, physical and chemical tests, such as specific gravity, degree Baumé, weight per gallon, refractive index, viscosity at 70, 120 and 180 deg. F., flashpoint, burning point, congealing point, color density, carbon content and free acid. There are manufactured in all commercial products such as oils of a supposedly certain grade, superior and inferior grades, sometimes perhaps beyond the control of the maker. Usually, however, the maker knows to whom he had best ship the inferior grade; his knowledge of this being based upon the fact that there is no inspection at the point where the inferior grade is shipped. I recall an instance where the price asked per gallon of 90-per cent. quality oil was the same as that paid for supposedly the same grade which had 64-per cent. quality.

After having carried on extensive tests of oils for gas and gasoline engines that were submitted by about twenty companies, I found it desirable to establish a rating or percentage of quality. This was arrived at as follows:

RULE FOR RATING OILS

A. Viscosity at 120 deg. F. × 1
Viscosity at 180 deg. F. × 10
Flashpoint × 1
Multiply and add the products.

B. Congealing point × 1
Free acid × 100
Carbon content × 100
Multiply and add the products.

Subtract B from A, divide by 5 and then multiply by the specific gravity. The result is the percentage of quality.

If the viscosity at 70 deg. F. is considered, divide 100 by this figure and add to the quantities in A.

Example:

Viscosity at 120 deg. F.	1 ×	2.09	= 2.09
Viscosity at 180 deg. F.	10 ×	1.22	= 12.22
Flashpoint	1 ×	402	= 402.00
			416.31
Congealing point	1 ×	20	= 20.00
No free acid			
No carbon content			
		A — B	= 396.31

396.31 ÷ 5 = 79.25
79.25 × 0.901 = 71.40 per cent.

Out of ten heavy crank-case oils computed in this way the quality varied from 96.94 to 50.94; of twelve crank-case and gas-engine oils the quality ranged from 80.5 to 56.94; of nine motor and automobile oils, from 73.27 to 60.24.

It is of course necessary to change the factors in the rule to suit the characteristics of various oils, such as cooling, thread-cutting, spindle, dynamo and special oils; or by using a fixed rule, one will see that oils with various characteristics are divided into classes after analysis. —*Power.*

Defining Jigs and Fixtures

By A. L. Haas

Jigs and fixtures are commonplace aids to machining, and their utility is such that modern machining would be impossible without them. Every mechanic knows quite well what is meant by the terms "jig and fixture," but they are so loosely applied in the average shop that the real difference in function is obscured.

These attachments are of endless variety, but all have common characteristics underlying their seeming divergence. To distinguish jig and fixture, it is necessary to define them not by similarity, but by function.

The characteristics common to both appliances are those of location, repetition and dimension of product. Reflection will, however, show that these alone will not separate them from templet and gage. The essential difference is that a jig serves to guide a cutting tool while a fixture locates the work operated on. Both are separate from the machine tool on which they are employed. The definitions that suggest themselves are:

Jig—A piece of apparatus serving to guide the cutting element of a machine tool.

Fixture—A piece of apparatus serving to locate and hold work on a machine tool.

These appear comprehensive until the matter is further examined. To narrow the field and cut out the ordinary appliances, such as angle plates, faceplates and the regular attachments of a machine tool, is desirable. The definition then becomes:

Jig—A piece of apparatus for rapid production of duplicate work within ascertained limits of error, serving to guide the cutting element of a machine tool.

Fixture—A piece of apparatus for rapid production of duplicate work within ascertained limits of error, serving to locate and hold the work on a machine tool.

It may be objected that the two functions may be and often are combined. For this the society precedent of a hyphen will serve. The combined attachment would be termed a jig-fixture or a fixture-jig. This may be defined as:

Jig-Fixture—A piece of apparatus for the rapid production of duplicate work within ascertained limits of error, serving to locate and hold the work and also guide the cutting element on a machine tool.

There is value in definite classifications and exact definition. Only by such means do we avoid lengthy description and misunderstanding; hence the foregoing proposals.

[The first thing to do is to settle definitely which is which. Recently we saw in the Pratt & Whitney works a very fine special machine tool for making a gun part and were told, upon inquiry, that it was a fixture.—Editor.]

Data on Whitworth Thread Gages

The increased use of Whitworth thread gages in connection with the extensive manufacture of British munitions has created additional interest in the methods employed in the manufacture of such gages.

Information is especially desired by a number of correspondents on thread cutting, grinding, hardening and lapping. Present-day British practice in the manufacture of such gages would no doubt prove both timely and unusually interesting.

Operations Followed in Making Commutators for Armatures

EDITORIAL CORRESPONDENCE

SYNOPSIS—In this article are shown various operations and methods of manufacturing commutators. The built-up sheets of mica are first sawed into strips of the desired width, which are sawed to the correct size to suit the insulator strip required. The copper bars are blanked out from a strip. A punch and die for this operation are shown. A fixture is used to assemble the bars and insulating strips to form the commutator. The subsequent machining operations are illustrated and described.

The H. P. Cameron Electric Manufacturing Co., Ansonia, Conn., manufactures a line of commutators both for the United States and for export trade.

In Fig. 1 is shown the saw that reduces built-up sheets of mica to strips of proper width. *A* is a sheet of mica and *B* a pile of sawed strips. On the table *C* are shown a number of the strips that have been sawed in blocks. In cutting the mica sheet the guide of the machine is set at the correct distance from the saw, and by guiding the sheet against the block the strip is cut to the desired width.

In Fig. 2 is shown one of the steel molds for making insulator rings. The mica strips are first notched and then placed in a die that rough-forms them to size. These forms are molded in the rings with the die shown. After the ring segments *A* have been removed, the mold is transferred to an oven and heated to 400 deg. F.

One of the rough-formed mica rings is placed in the mold *B*, also a quantity of liquid shellac. The steel segments are put in position on top of the mica ring. The mold is set under a screw press, and pressure is applied by hand until the segments have been forced down to the correct depth. The mold is left under the press to cool. The steel segment may then be removed and the molded mica ring taken out. One of the mica rings made in this mold may be seen at *C*. In Fig. 3 are shown molded mica rings of various sizes, the largest being 10⅞ in. in diameter and the smallest ¾ in. in diameter.

The punch and die for punching out copper bars are illustrated in Fig. 4. The copper, which has been made to the correct width and section, is fed into the die at *A* against the stop *B*. The punch *C* is brought down with the machine and the bar blanked out. One of the blanked bars is shown at *D*. In making the punch and die regular practice is followed.

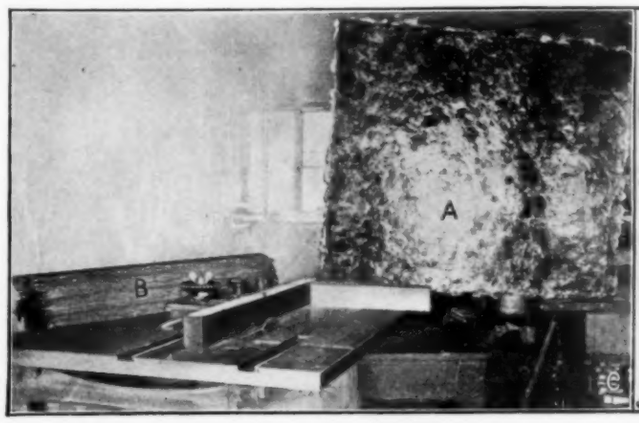


FIG. 1. SAW FOR SLITTING MICA SHEET

FIG. 2. STEEL MOLD FOR INSULATOR RING

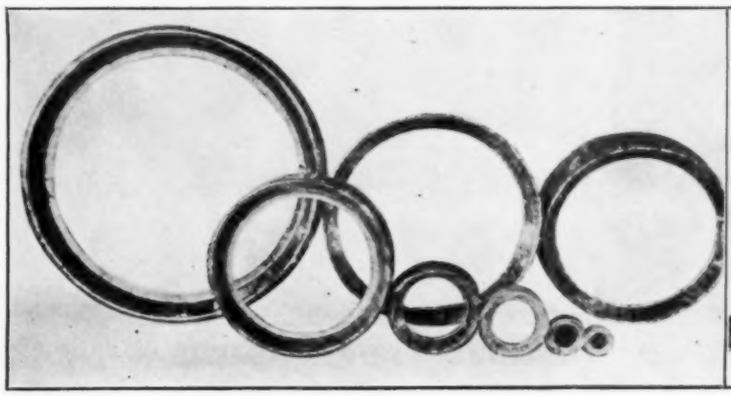


FIG. 3. NUMBER OF MOLDED MICA RINGS

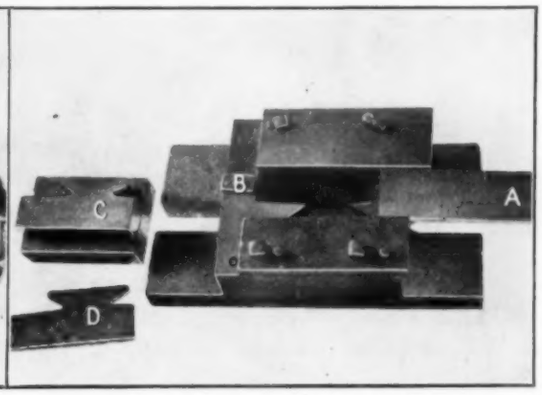
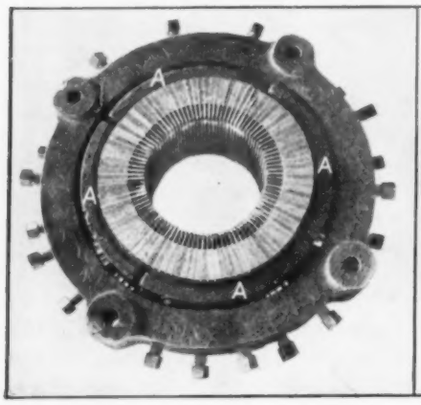
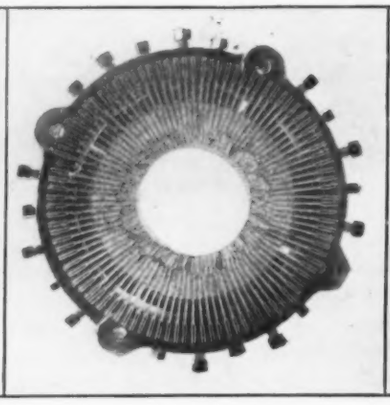


FIG. 4. PUNCH AND DIE FOR COPPER BARS

The fixture for building up a commutator is reproduced in Fig. 5. The copper bars are placed in the fixture with a mica strip between each pair. The screws on the outer periphery are tightened against the circular strips *A*, the After the commutator has been assembled, it is placed over the furnace at *A*. Gas is admitted and regulated by the pipe *B*. The heat is allowed to come against the commutator until the shellac has been melted out of the mica.





FIGS. 5 AND 6. FIXTURE FOR BUILDING UP A COMMUTATOR

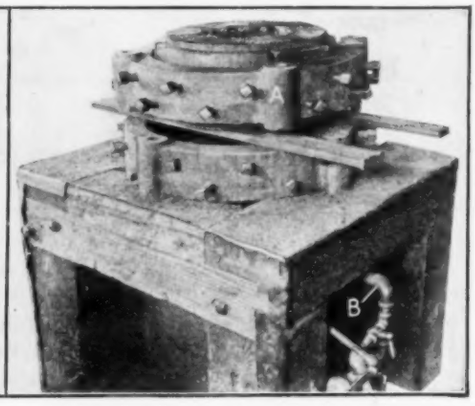


FIG. 7. GAS-OPERATED FURNACE

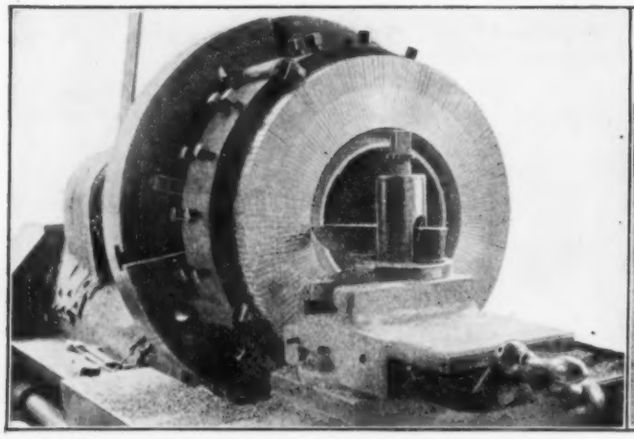


FIG. 8. TURNING COMMUTATOR FACE

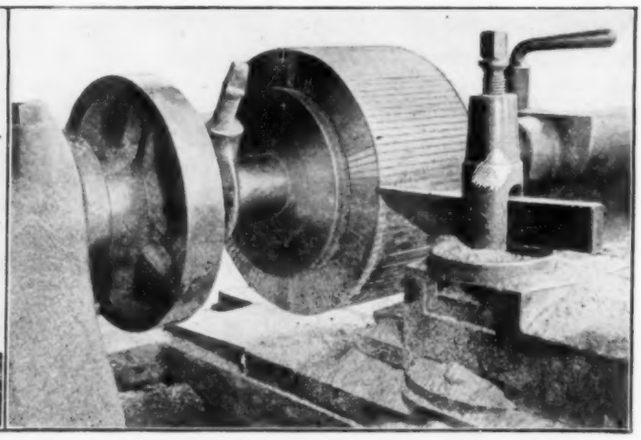


FIG. 9. TURNING OUTSIDE OF COMMUTATOR

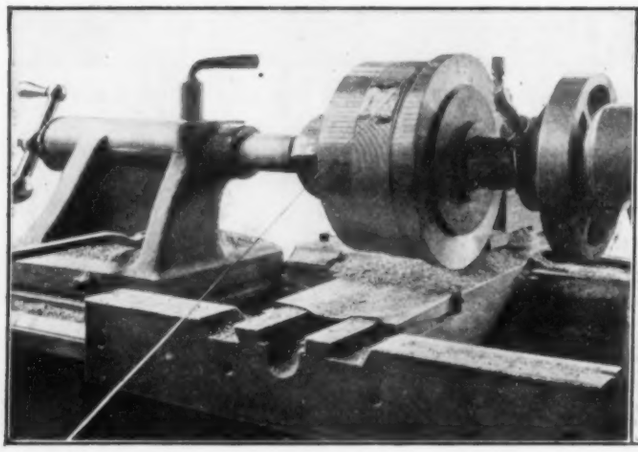


FIG. 10. WINDING BINDING WIRE ON COMMUTATOR

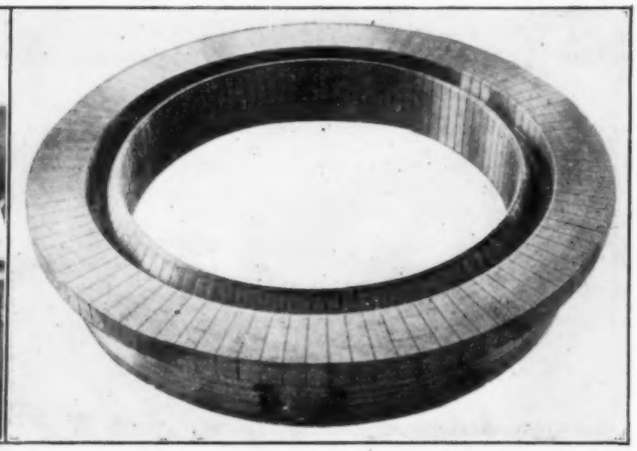


FIG. 11. VIEW OF COMMUTATOR AFTER BEING WOUND

pressure on which forces in the segments. Pressure is applied at various points on the fixture until the ring is circular and the commutator segments held tight. A rear view of the assembled commutator and fixture is given in Fig. 6.

In Fig. 7 is shown the gas-operated furnace for extracting the shellac that is in the mica insulations. The fixture is removed and the screws tightened to take up any space that had been occupied by the shellac.

The fixture and commutator are then placed in the lathe, Fig. 8, being held by bolts placed in the faceplate slots and through holes in the fixture. The outside face and edge of the commutator are turned and the hole is bored. The V-surface of the commutator is also ma-

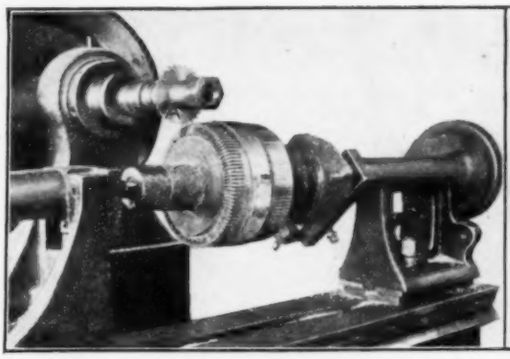


FIG. 12. SLOTTING THE ENDS OF BARS FOR THE LEADS

FIG. 13. THE FINISHED COMMUTATOR

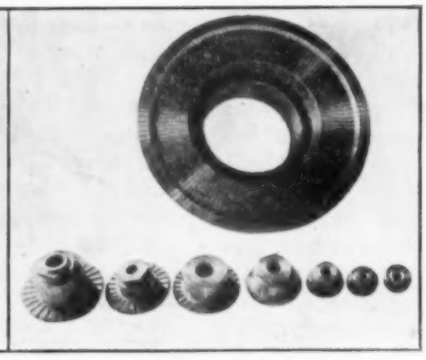


FIG. 14. NUMBER OF VARIOUS SIZES OF COMMUTATORS

chined, a gage being used to test the correctness of the contour.

The commutator is removed and an arbor placed in the bored hole. A nut is tightened, forcing the commutator against a shoulder on the arbor and holding it securely. The outside of the commutator is turned to size, as shown in Fig. 9.

This factory has adopted the practice of banding the assembled commutators with a tinned wire over insulating paper. By this method the commutator may be tested before being placed on the armature. In Fig. 10 is illustrated this operation of winding the wire over the paper. One of the commutators after being wound is seen in Fig. 11. This commutator is 13⅝ in. in diameter and has 99 bars.

After the commutator has been wound with the retaining wire, the ends of the bars are slotted for the leads, as shown in Fig. 12. The commutator is held on an arbor and indexed around the various positions with an indexing wheel and pointer. With the wheel *A* revolving, the table carrying the commutator is fed along the required distance and the ends of the bars slotted.

In Fig. 13 is shown a finish-machined commutator, slotted ready for attaching to the armature. This commutator has 111 bars and is 9⅝ in. in outside diameter. A number of various types and sizes of commutators are illustrated in Fig. 14. The largest is 13 in. in outside diameter and the smallest is 1 1/16 in.

Hand Wire-Bending Fixtures

By George P. Breitschmid

It takes five distinct operations to make from 0.036-in. music wire the spring shown in Fig. 1. A general description of the tools follows:

In the first-operation fixture, Fig. 2, *A* is a cast-iron base milled at *B* for holding in a vise, so that the operator has free use of both hands to place the work and operate the fixture. The wire is first straightened and cut off in lengths of 2½ in., then placed in the fixture, one end of which is gaged by the stop *C;* the other end is located between the gage *D* and the pin *E*, which is a drive fit in the wiper *F*, operated by the handle *G*.

After placing the work as directed, operate as follows: Draw handle *G* forward, which makes the wiper *H* grip the wire, carrying it around the pin *E* until the handle *G* completes its movement by bringing up against *I*, an adjustable stop, thereby completing the work, forming a half-loop at one end, as shown.

The second-operation fixture, Fig. 3, is almost identical in construction with that for the first operation, employing a similar cast-iron base and round wiper operated by a handle, but has the following differences: The wiper *A* is of one-piece construction, milled with a right angle, as shown at *B*. The gage *C* is milled at *D* with a slot to hold the wire. The gage *E* carries a pin that also helps to locate the wire at or by the loop made on the first-operation fixture. It will also be noticed that the gage *E* is milled on an angle, to give the loop the desired shape. The gage *C* is milled on an angle at *F*, allowing the wire to be forced enough past a right angle to take care of any spring back, so that when completed the wire will be bent as required.

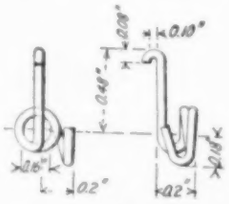


FIG. 1. PART TO BE MADE

The fixture for operation 3, Fig. 4, is also of the same construction as the preceding ones, employing a cast-iron base *A* and right-angle tool-steel wiper *C* actuated by the handle *D*. The work is held in the path milled in

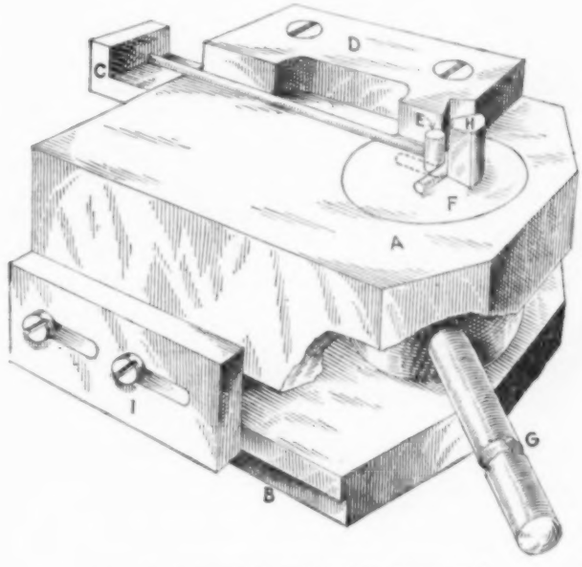
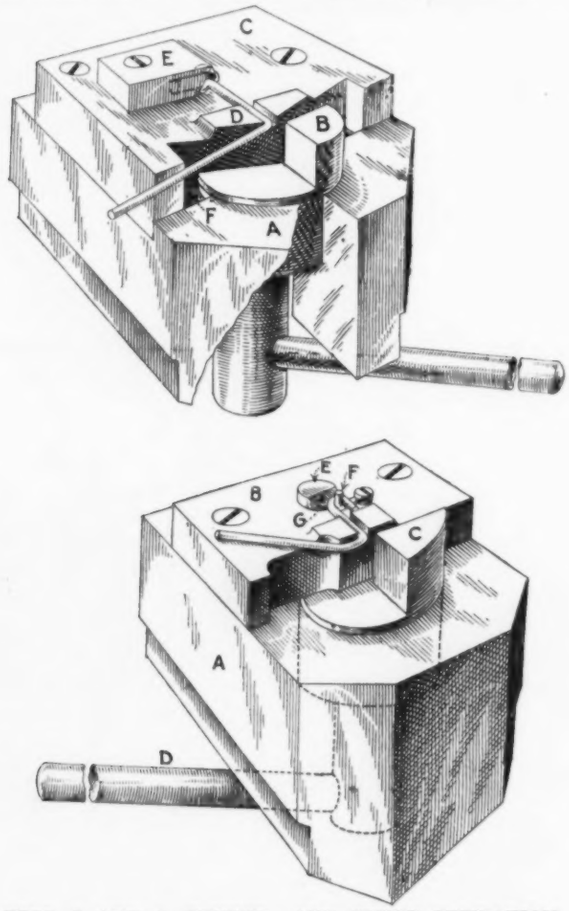


FIG. 2. FIRST-OPERATION FIXTURE

the raised surface is on the gage plate *B*, which also carries a stationary pin *E* that in turn has a milled angular surface *G* acting as a locating point using the loop formed by the first-operation fixture.

The spring pin *F* trips to keep this loop against the milled surface *G* and is fixed to the gage *B* by a No. 5-40 screw in a threaded hole. While the fixture is similar to the second-operation tool, the method of holding the work is of interest, as is also the fact that here we have a very short bend, which is usually annoying in music wire. The handle is rotated until *C* brings up at the stop, finishing the operation. The work may be easily removed by returning the parts to their normal position and depressing the pin *E*.

The fifth-operation fixture, Fig. 6, in general design and construction is similar to the fixtures for the first,

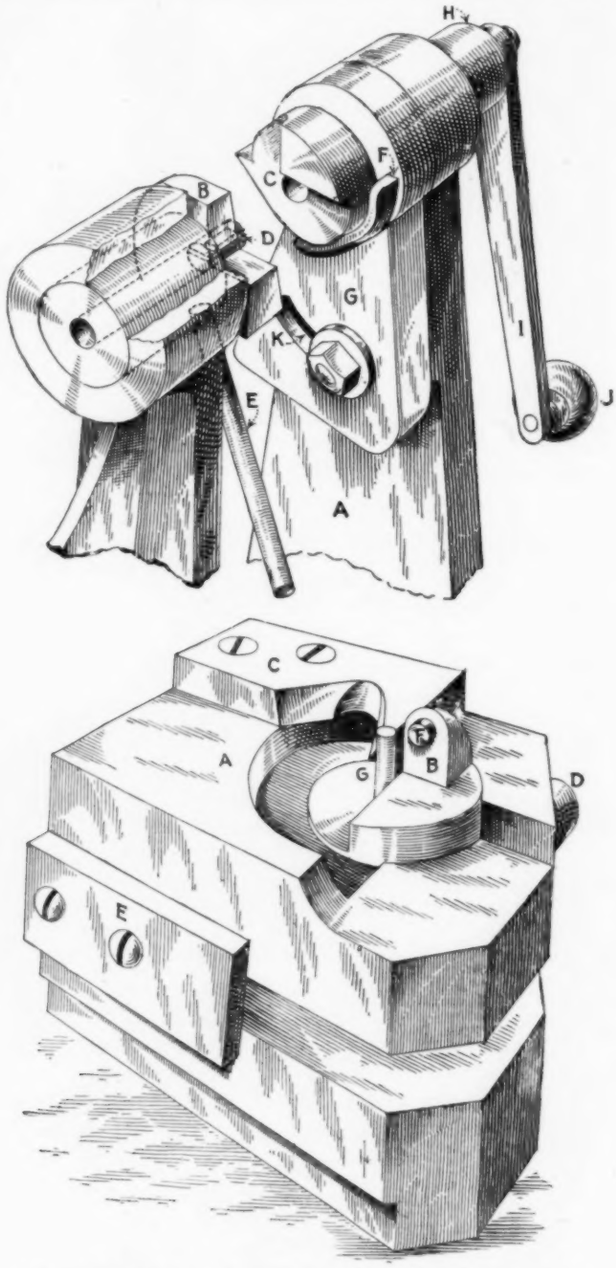


FIGS. 3 AND 4. SECOND- AND THIRD-OPERATION FIXTURES

second and third operations, but the method of holding the work is different. The cast-iron base *A* is milled with two cuts on the bottom for holding in a bench vise. At *B* is a tool-steel wiper with a lug raised upon it for the holding pin *F* and the center pin *G*; while *C* is a gage plate of tool steel, and *E* is a stop that may be made with adjustment.

The method of operating is as follows: Place the work with two close coils upon the pin *F*, allowing the straight end to lie between the pin *G* and the gage plate *C*. Operate as in preceding fixtures until the handle *D* brings up at the stop *E*. This completes the final bend. The labor cost of making this piece does not exceed 20c. per hundred for all five operations.

The fixture shown in Fig. 5 performs the fourth, or coiling, operation. The main portion *A* is of cast iron, with two columns bored to receive the members *B* and *H*. *B* is a tool-steel locating piece carrying the locating pins *E* and *D*, which are made of drill rod. As the work is of 0.036-in. music wire and it is desired to wind two close coils, it will be necessary to machine the face of *B* to form a cam. The rise must correspond to the thickness



FIGS. 5 AND 6. FOURTH AND FIFTH OPERATIONS

of the wire. This can be done by gearing a lathe to cut 28 threads per inch. *H* is a machine-steel stud actuated by the crank *I* and the handle *J* and carrying the tool-steel wiper *C*, which is also machined camlike, corresponding to the thickness of the wire. At *G* is a machine-steel piece located on the right-hand column and the carrier stop *F*. It will be seen that *G* can be swiveled along the path *K*, allowing the stop to be advanced or retarded, depending upon the temper of the wire.

The tool is operated as follows: As the wire is delivered by the third-operation fixture, the third-operation bend is inserted in the path of *D* so as to engage the loop made by the first-operation fixture.

Making the 4.5-In. Howitzer Cartridge Case--I*

By Robert Mawson

SYNOPSIS—In this article are described the successive operations in manufacturing the 4.5-in. howitzer cartridge case. The machines used are shown set up with the tools as in operation, performing the various stages on the work. Detail illustrations are also given of the tools and of the special equipment that has been developed to enable the manufacturers to turn out an accurate product. Thus the article is a complete description of the manufacturing processes followed in making this cartridge case.

Under ordinary conditions the manufacturing of war munitions calls for exceptional thought and skill, owing to the lack both of knowledge and of proper tools. During the present European War, when a firm has been offered an order, time has been at a premium. Often

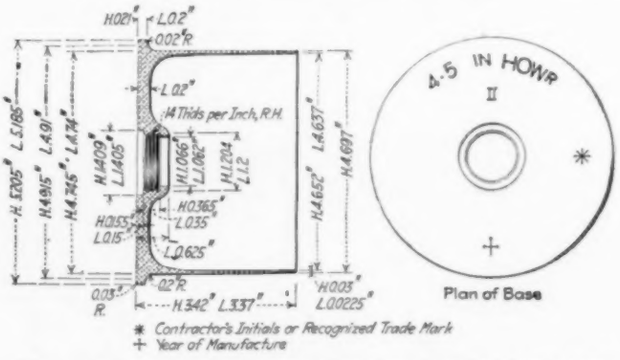


FIG. 1. DETAIL OF 4.5-IN. HOWITZER CARTRIDGE CASE

special machines could not be obtained, and the lack of time has prevented the firm from making its own.

The Worcester Pressed Steel Co. has had considerable experience in making pressed parts in various metals, and one would judge that the manufacturing of a cartridge case would be a simple matter for this concern. Yet it found some experiments necessary before a case to pass the British Government inspection was produced. The company is manufacturing the 4.5-in. British howitzer cartridge case, and the present production is 75,000 per week. The composition from which the cases are made is 70% copper and 30% spelter. The sequence of operations is given in the accompanying table.

TABLE OF SEQUENCE OF OPERATIONS

1. Blank—purchased
2. Cupping
3. First indent
4. Second indent
5. Anneal and pickle
6. Flatten base
7. First draw
8. Wash, anneal and pickle
9. Second draw
10. Wash, anneal and pickle
11. Third draw
12. Trimming
13. Wash and pickle
14. Fourth draw
15. Wash, anneal and pickle
16. Fifth draw
17. Trimming
18. Wash
19. First heading
20. Second heading
21. Final trimming
22. Pierce for primer hole
23. Tapering
24. Shop inspection
25. Face, square to length, rough-thread and counterbore for primer
26. Finish-thread
27. Finish-counterbore
28. Face inside of boss
29. Wash
30. Final inspection
31. Stamping
32. Packing

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A detail of the case is given in Fig. 1. In Fig. 2 are illustrated the various stages that the case passes through from the blank till it is ready for packing. The blanks are purchased and measure 5⅞ in. in diameter by 0.380 in. thick. The next operation, given as the

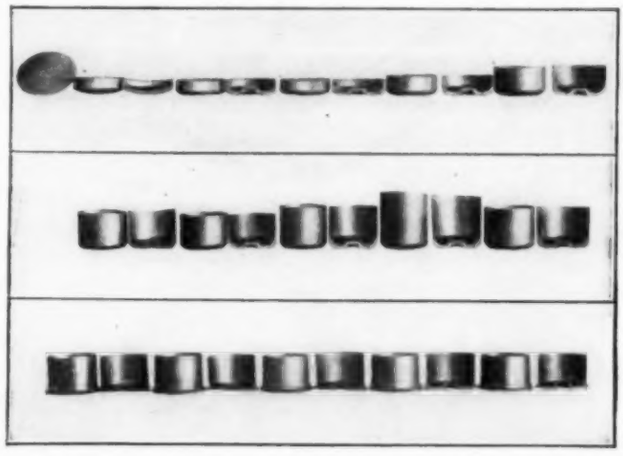


FIG. 2. VARIOUS STAGES OF 4.5-IN. CARTRIDGE CASE FROM BLANK TO FINISHED PART

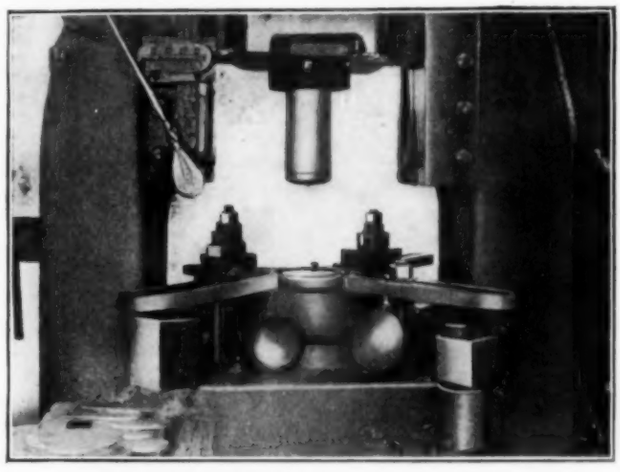
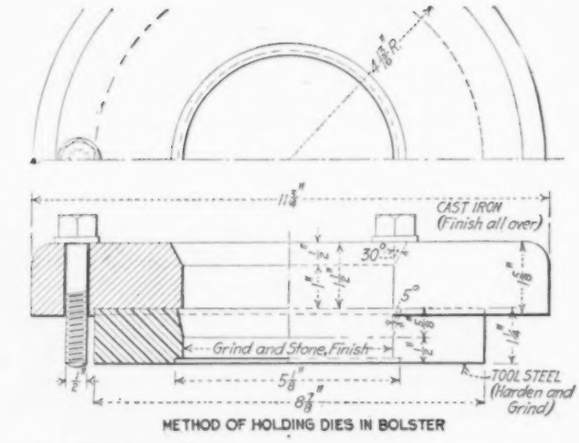
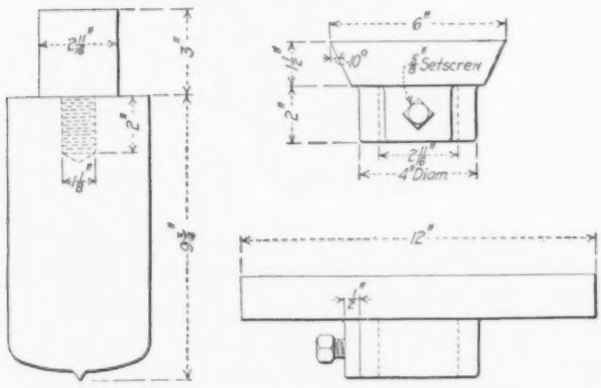


FIG. 3. THE CUPPING OPERATION

second in this article, is cupping. The machine performing this work is seen in Fig. 3. The punch, punch holder, bolster and drawing dies are shown in Fig. 4. The cupping operation is given in diagrammatical form in Fig. 5. During the various punch-press operations the cases are lubricated with Lub-a-Tube made into a solution with the proportions of 30 lb. of the composition to 50 gal. of water.

The next operation is making the first indent. This is done on the press illustrated in Fig. 6. The punch, Fig. 7, and the die, bolster and center-section knock-out, Fig. 8, are used. The punch is fastened to the punch press with a holder, Fig. 5, similar to that for the cupping operation. The first indenting operation is also given in diagrammatical form in Fig. 9.





CUPPING PUNCH AND PUNCH HOLDER

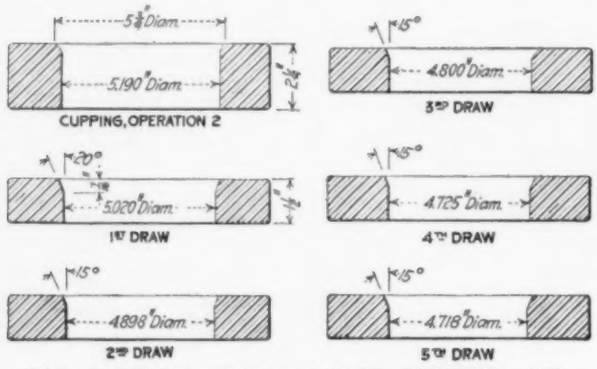


FIG. 4. PUNCH, PUNCH HOLDER, BOLSTER AND DRAWING DIES

The part then receives a second indenting on the punch press, Fig. 10. The reason for this second indenting operation is that a better case is thus produced and, as is obvious, it also avoids the use of an extra-large press. For this work, the punch, Fig. 11, the die bolster and the center-section knock-out, Fig. 8, are utilized; also the punch holder, Fig. 4. The second indenting operation is given in diagrammatical form in Fig. 12.

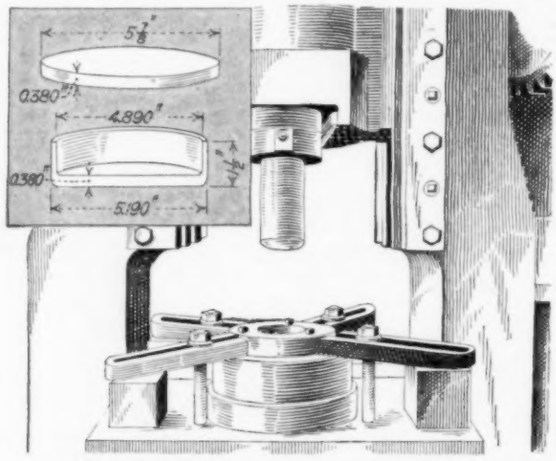


FIG. 5. OPERATION 2: CUPPING

Machine Used—12-in. stroke Bliss.
Production—550 per hr.
Pressure—210 tons.
References—Figs. 3, 4 and 5.

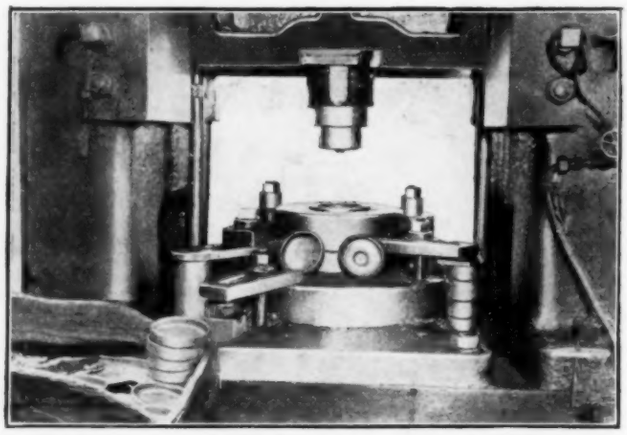


FIG. 6. FIRST INDENTING OPERATION

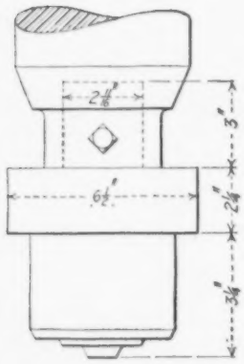


FIG. 7. THE PUNCH

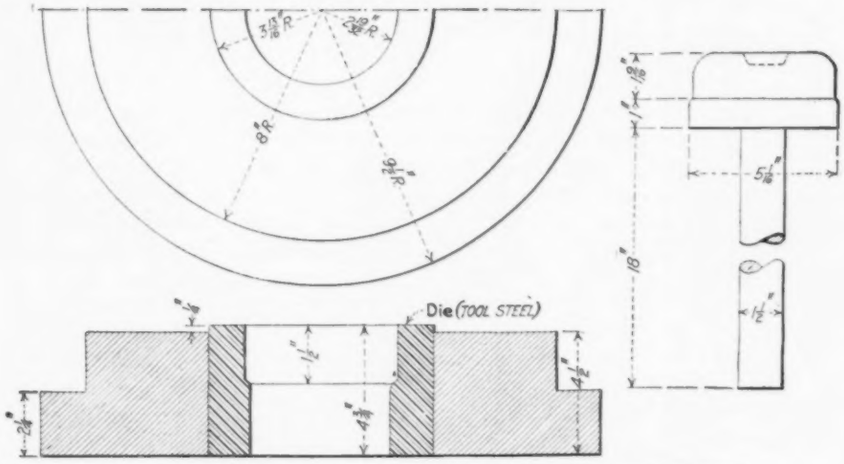


FIG. 8. DIE, BOLSTER AND CENTER-SECTION KNOCK-OUT

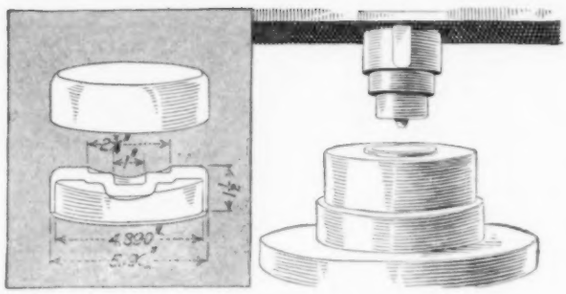


FIG. 9. OPERATION 3: FIRST INDENT
Machine Used—Toledo 18-in. stroke.
Production—500 per hr.
Pressure—400 tons.
References—Figs. 5, 7, 8 and 9.

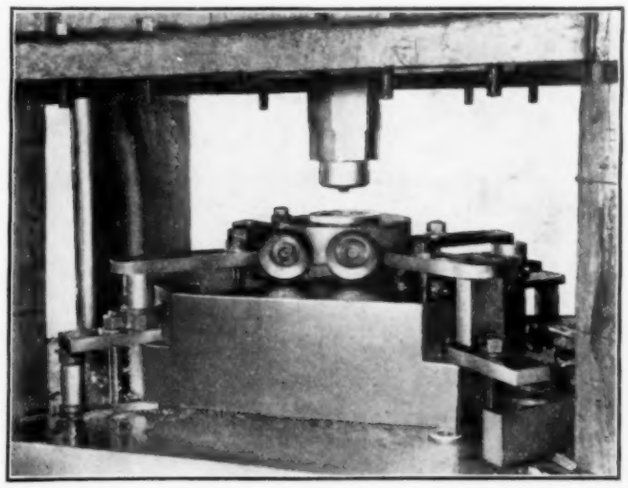


FIG. 10. SECOND INDENTING OPERATION

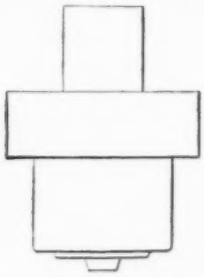


FIG. 11. PUNCH FOR SECOND INDENT

The next process is annealing and pickling the parts. They are placed on trays and slid into a crude-oil oven, Fig. 13. Three such ovens are provided at the factory for this work, each one holding four 44-in. square pans, in each of which approximately 110 cartridge cases may be placed. The ovens are kept at a temperature of 1,250 deg. F., and the cases are left in the ovens 36 min. The annealing operation is conducted so that a pan is removed from the rear of the oven every 9 min. As the pan is removed, another is placed at the front of the oven. This procedure enables the annealing operation

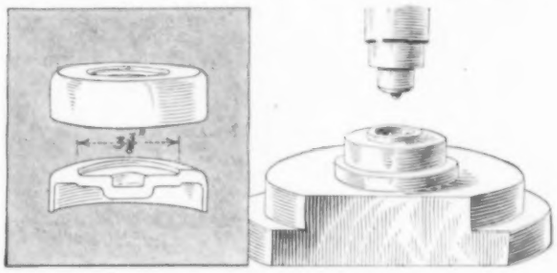


FIG. 12. OPERATION 4: SECOND INDENT
Machine Used—Toledo 26-in. stroke.
Production—450 per hr.
Pressure—400 tons.
References—Figs. 5, 9, 11 and 12.

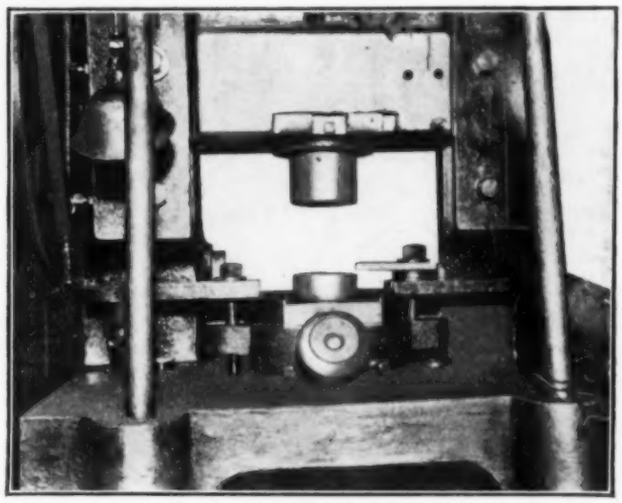


FIG. 15. FLATTENING THE BASE OF THE CASE

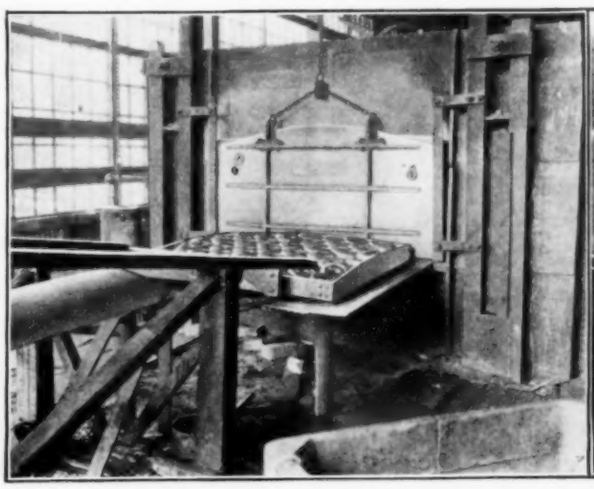


FIG. 13. ANNEALING TANKS

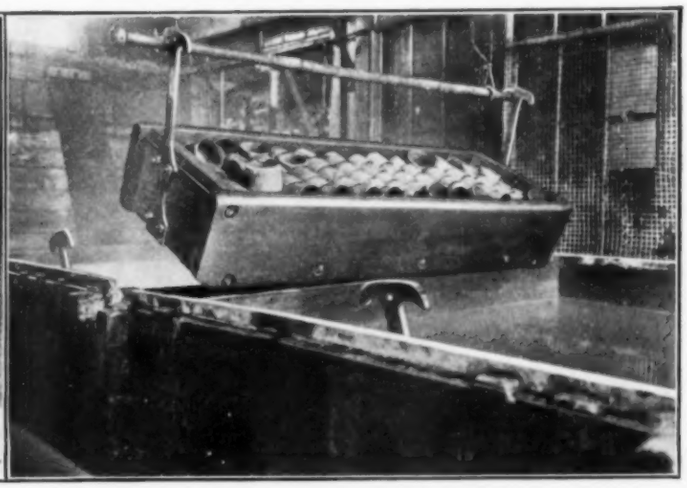


FIG. 14. WASHING AND PICKLING TANKS

to be a continuous one. The three ovens anneal 11,000 cases in 24 hr., requiring 504 gal. of oil.

When the pan has been taken from the oven, the cases are quenched in cold water. They are then conveyed, by means of a 1,000-lb. air hoist, to the pickling tanks, Fig. 14. The solution consists of one part sulphuric

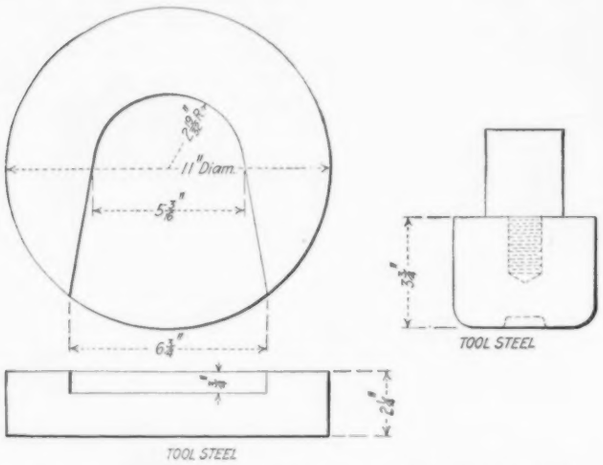


FIG. 16. PUNCH AND DIES FOR FLATTENING BASE

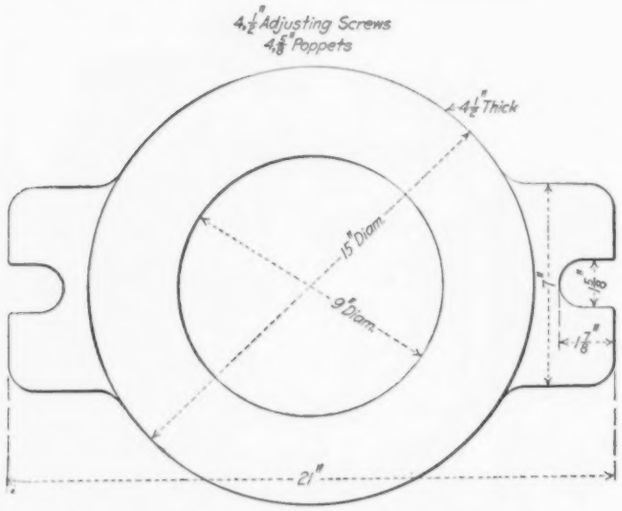


FIG. 17. BOLSTER FOR BASE-FLATTENING DIE

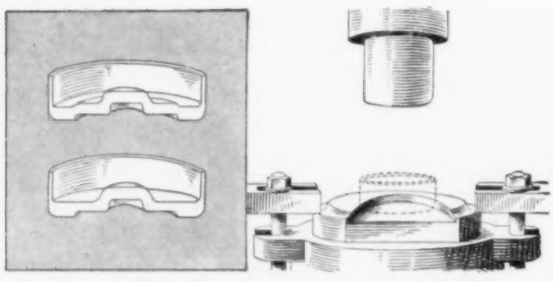


FIG. 18. OPERATION 6: FLATTENING BASE
Machine Used—Toledo 8-in. stroke.
Production—1,100 per hr.
Pressure—100 tons.
References—Figs. 5, 16, 17 and 18.

acid to ten parts water. The cases remain in the pickling tank about 5 min. The parts are then carried to the punch press, Fig. 15, where the base is flattened, so that the cases will present a good surface for the first

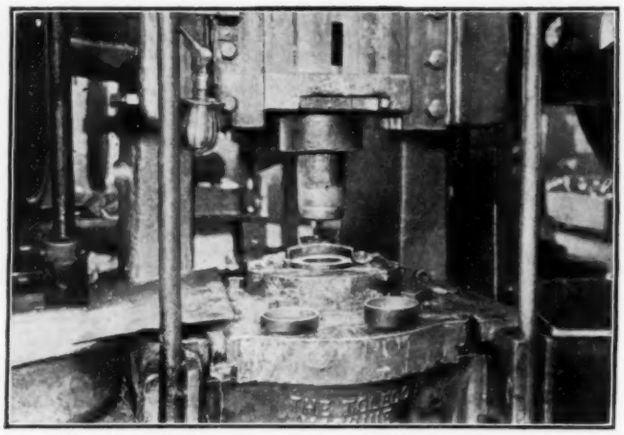


FIG. 19. FIRST DRAWING OPERATION

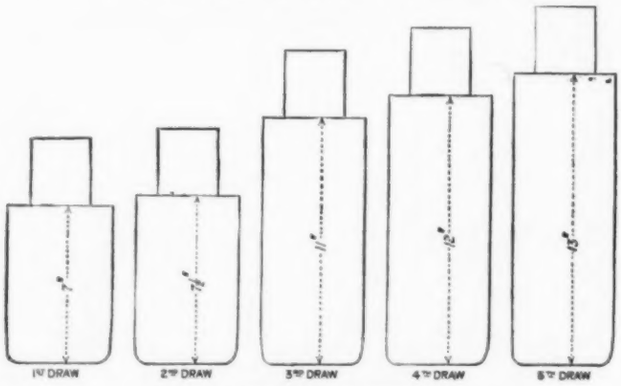


FIG. 20. DRAWING PUNCHES

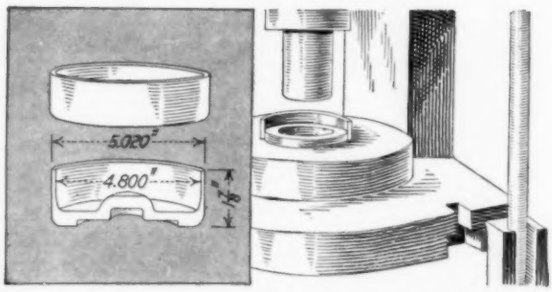


FIG. 21. OPERATION 7: FIRST DRAW
Machine Used—Toledo 8-in. stroke.
Production—900 per hr.
Pressure—100 tons.
References—Figs. 5, 18, 21 and 22.

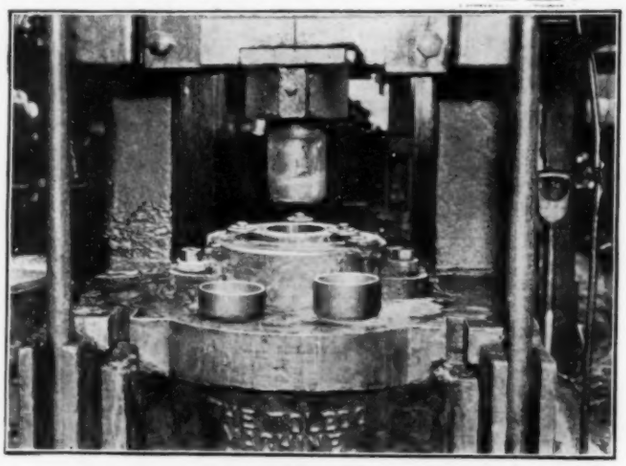


FIG. 22. SECOND DRAWING OPERATION

drawing operation, in which the punch and die, Fig. 16, are used. The die is held with bolts on the bolster, Fig. 17. The punch is placed in the holder, Fig. 4. The operation is also given in diagrammatical form in Fig. 18.

The case is now ready for the drawing operations. The first of these is performed in the punch press, Fig. 19. The drawing punches, Fig. 20, are fastened to the machine by the punch holder, Fig. 4. The die is illustrated in Fig. 4. It is held in the bolster, Fig. 17. The operation is shown in diagrammatical form in Fig 21. The cases are washed in a hot-water and caustic soda solution for about 1 min. They are afterward annealed, quenched in cold water and pickled in a similar manner to that described for operation 5.

The parts are then conveyed to the machine, Fig. 22, for the second drawing. The punch, Fig. 20, inserted

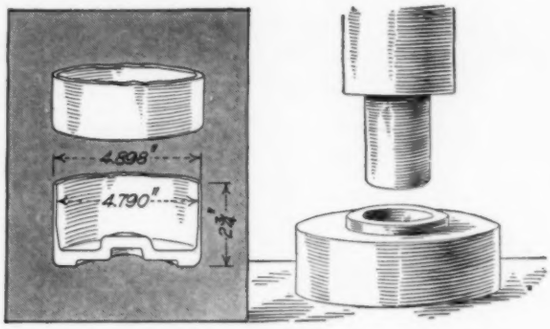


FIG. 23. OPERATION 9: SECOND DRAW
Machine Used—Bliss 12-in. stroke.
Production—550 per hr.
Pressure—75 tons.
References—Figs. 5, 18, 24, 25 and 26.

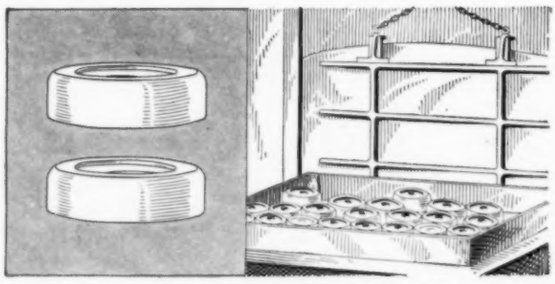


FIG. 24. ANNEALING OPERATION

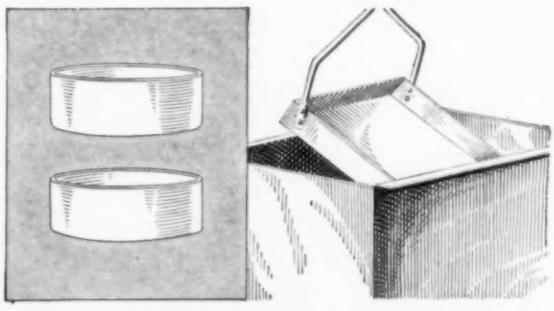


FIG. 25. PICKLING OPERATION

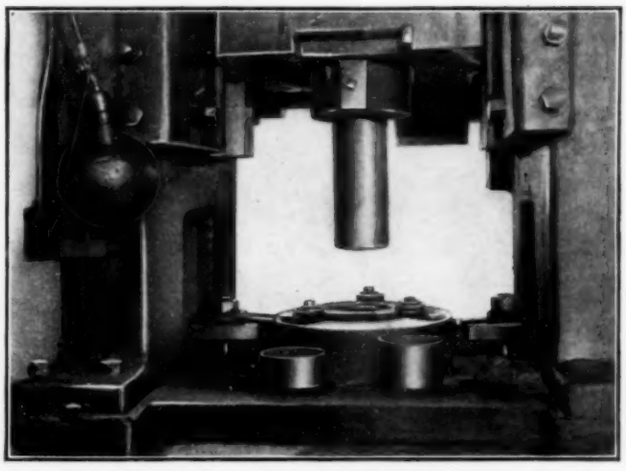


FIG. 26. THIRD DRAWING OPERATION

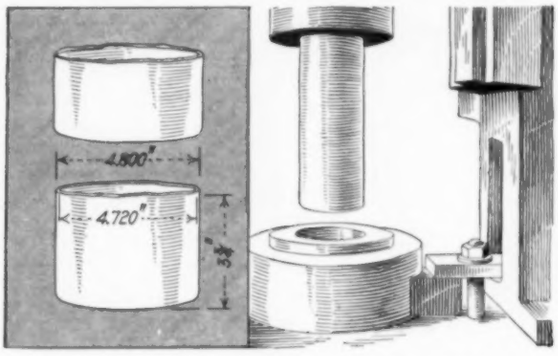


FIG. 27. OPERATION 11: THIRD DRAW
Machine Used—Bliss 12-in. stroke.
Production—550 per hr.
Pressure—75 tons.
References—Figs. 5, 18, 28, 29 and 30.

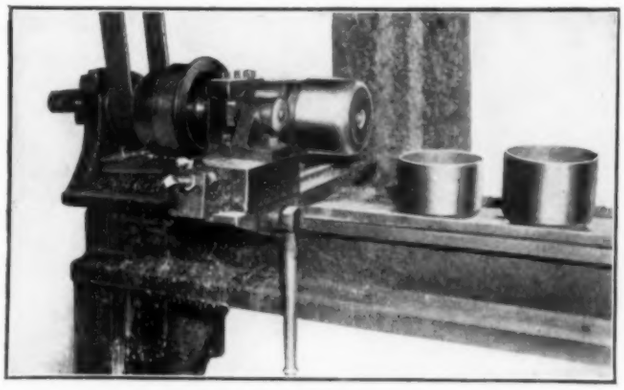


FIG. 28. CASE-TRIMMING LATHE

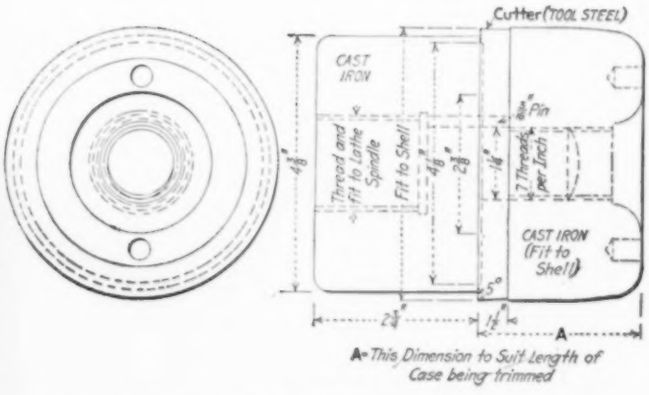


FIG. 29. MANDREL AND CUTTER FOR TRIMMING

in the holder, Fig. 4, and the die, Fig. 4, held in the bolster, Fig. 17, are the tools for this second drawing operation, which is seen in diagrammatical form in Fig. 23. The cases are then washed, annealed and pickled in

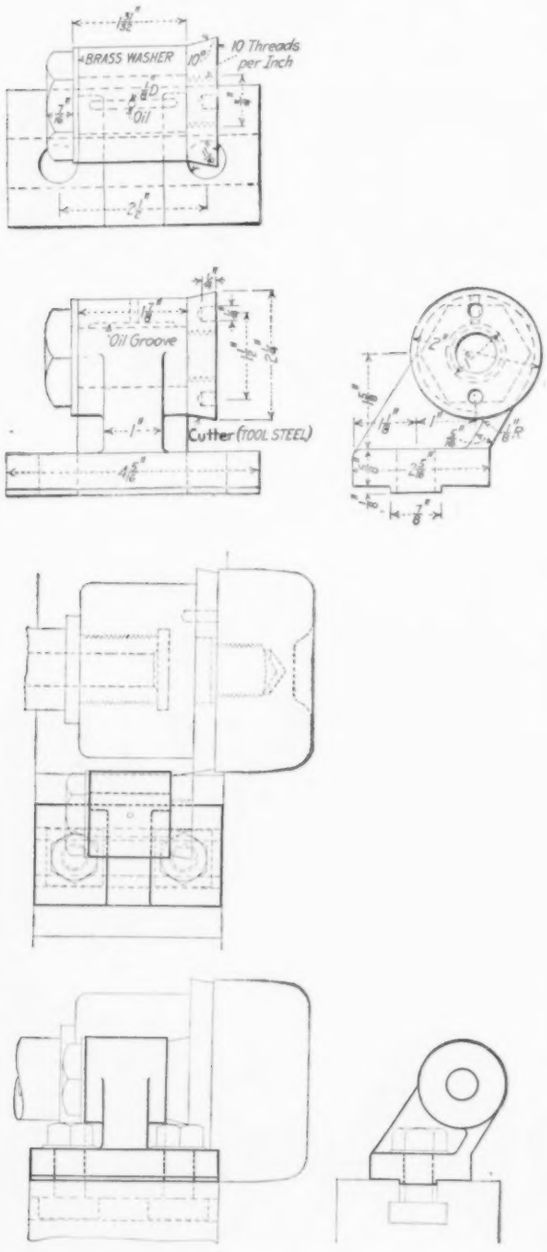
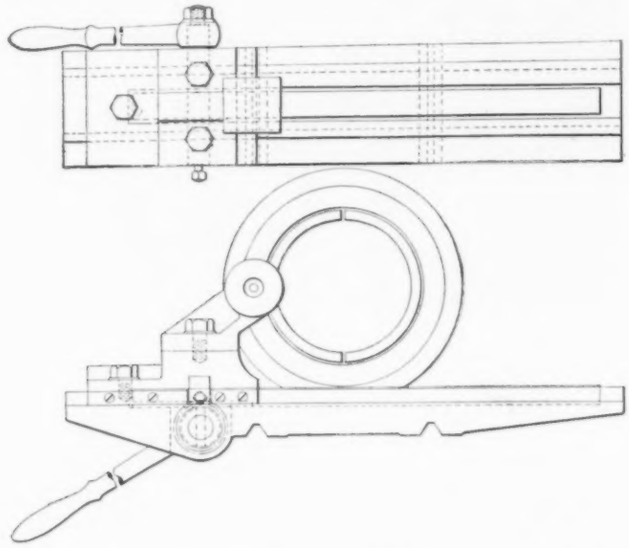


FIG. 30. DETAILS OF TRIMMING LATHE

a manner similar to that described in operations 5 and 8 and shown in diagrammatical form in Figs. 24 and 25.

The next operation, the third drawing, is performed on the machine illustrated in Fig. 26. The tools are a punch, Fig. 20, a punch holder, Fig. 4, a die, Fig. 4, and a bolster, Fig. 17. A diagrammatical illustration of the operation appears in Fig. 27.

The cases are then trimmed to 3⅜-in. long in the lathe shown in Fig. 28. The case is held on a cast-iron chuck that is made with its length to suit the case to be trimmed. Back of this chuck is a tool-steel disk. The chuck, disk and shank are attached to the spindle of the lathe. The circular cutter is operated by a handle on the cross-slide. As the case is revolved, the cutter is slid against it; and as the case is held against the hardened tool-steel disk, the edge is trimmed off smoothly.



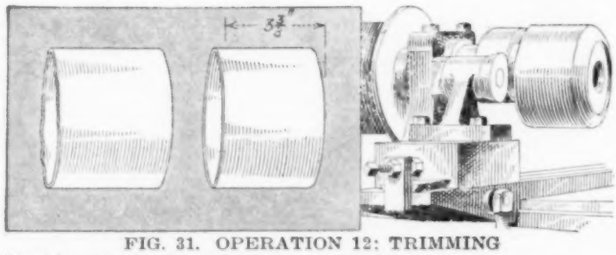


FIG. 31. OPERATION 12: TRIMMING
Machine Used—Special high-speed lathe.
Production—250 per hr.
References—Figs. 32 and 33.

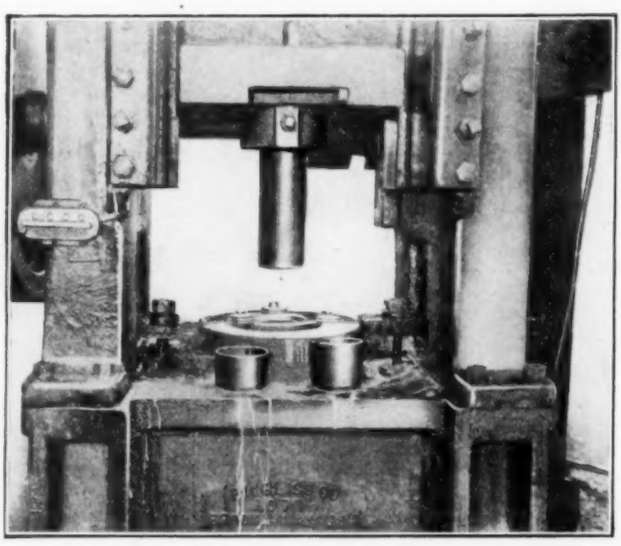


FIG. 32. FOURTH DRAWING OPERATION

Details of the trimming tools are given in Figs. 29 and 30. This trimming operation is shown in diagrammatical form in Fig. 31. The cases are washed, annealed and pickled, as previously described.

The next operation is the fourth drawing, which is performed in the punch press, Fig. 32. The tools for

this operation are the punch, Fig. 20, punch holder, Fig. 4, die, Fig. 4, and bolster, Fig. 17. The drawing operation is seen in diagrammatical form in Fig. 33. The cases are washed, annealed and pickled, as previously described, with the exception that the time of annealing is only 20 min.

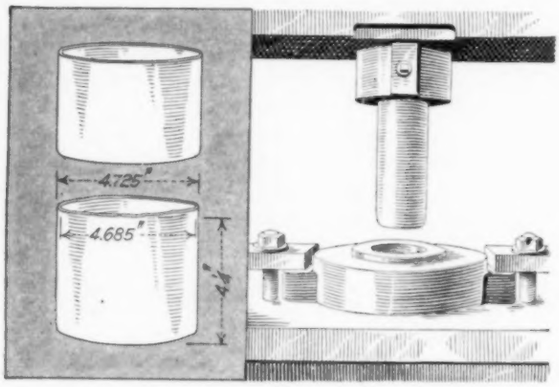


FIG. 33. OPERATION 14: FOURTH DRAW
Machine Used—Bliss 12-in. stroke.
Production—550 per hr.
Pressure—75 tons.
References—Figs. 5, 18, 35, 36 and 37.

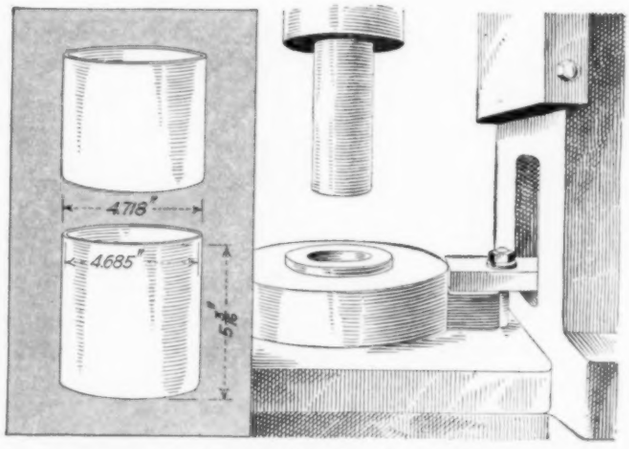


FIG. 35. OPERATION 16: FIFTH DRAW
Machine Used—Bliss 12-in. stroke.
Production—450 per hr.
Pressure—60 tons.
References—Figs. 5, 18, 39, 40 and 41.

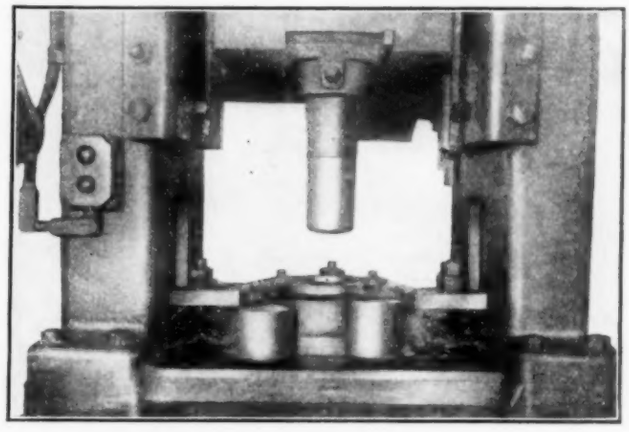


FIG. 34. FIFTH DRAWING OPERATION

The cases are then ready for the fifth, or final, drawing operation. This is performed in the machine shown in Fig. 34. Details of the tools for this operation are given in the following illustrations: Punch, Fig. 20; punch holder, Fig. 4; die, Fig. 4, and bolster, Fig. 17. A diagrammatical illustration of this operation, which completes the drawing work performed on the cartridge case, is given in Fig. 35.

(To be continued)

Some of the Work Required of an Aeroplane Mechanic

By Frank C. Hudson

The tremendous activity in aëronautics on the other side and the probable increase in the numbers of flying machines in this country in the near future open up the question of securing mechanics familiar with the sort of work necessary in looking after aëroplanes in commission, as well as the kind of men needed in building the machines. While it will probably be some time before we have any large number of commercial hangars in the same way that we now have commercial garages, there will nevertheless be a demand for mechanics who understand the keeping of aëroplanes in flying order, for like all kinds of machinery they require attention to keep them at their best and to make them as safe as possible.

As far as the motor is concerned, it is of course the same in principle as the automobile motor, the details of construction adopted by different makers being a subject for study by ambitious mechanics, as in the case of the automobile.

In caring for the aëroplane itself, as well as the various appliances now becoming part of its equipment, a few suggestions may be of value. These will include mostly the handling of the wires for various controls and supports and the method of making good electrical contacts for searchlights, stabilizers or other electrical apparatus used. In addition to this a mechanic should understand the operation and construction of the air compass, the drift indicator, the use of bomb-sighting and other devices.

Most of the wires are stranded cables, each strand being itself twisted up from smaller wires. One of the first things to learn is how to handle this cable without having the ends fray out and become unmanageable. The ends of the wire will usually be found soldered together. When it is necessary to cut off a piece, measure off the desired length from the end and mark it with chalk or otherwise on the wire cable. With a soldering iron, coat the cable with solder all around, for perhaps ½ or ¾ in. each side of the point at which it is planned to make the cut. This keeps the wire solid at that point; then when the cut is made, both ends are held firmly in position and no fraying takes place. This operation is illustrated in Fig. 1, where the wire is soldered from *A* to *B*, the cut being in the center, as shown. Fig. 2 represents the result of not soldering. The end *A* was previously soldered. Then the cable was cut at *B*, and the cable promptly untwisted clear to the soldered end, as shown.

For making electrical contacts the method presented in Figs. 3 and 4 is very successful. It is desired to put a substantial terminal for the contact screws at the end of a small insulated-wire cable. After cutting

the wire, it is advisable to slide the outer covering back, if it is of a sufficiently loose weave to allow this. Then trim off the inner insulation, exposing the bare wires, as at *A*, Fig. 3. These wires are divided about equally, as shown; the small contact washer, seen in section at *C*, Fig. 4, is placed between the two grooves, and the wires are carefully twisted on both sides of this ring, as at *A* and *B*, Fig. 4. The wire fits down into the groove; and after the wire is covered with some good noncorrosive soldering paste, the groove is filled with solder from a properly heated iron. The wire on both sides of the ring is also soldered fast. Then the surplus wire at the outer end is cut off as close to *B* as seems advisable, leaving a good substantial terminal. Care should be taken not to use too much solder, as it may make a lump on one side of the ring or fill the hole. In case this is done, however, it can be drilled out with a little care. Then slide the cover back over the wire and tape it.

Another form of electrical connection is illustrated in Fig. 5, where the ends of the fine wires in the cable are twisted together and soldered to one side of a regular copper washer *A*. This should be substantially done at the joint *B*. Taping is very necessary at all joints, not only on account of the electrical contacts, but to keep out moisture. This is particularly true in the flying boat, or hydro-aëroplane, for the salt water is thrown to a considerable distance in rough or stormy weather.

Electrical-Wire Joints

Fig. 6 is a diagram of the regular electrical contact, generally known as the Western Union splice. As can be seen, both wires are bent at right angles and then, instead of being doubled back on itself, each end is wrapped carefully around the other wire. This makes a long, strong contact. It should be carefully soldered, to insure a good connection. Taping is done in all cases.

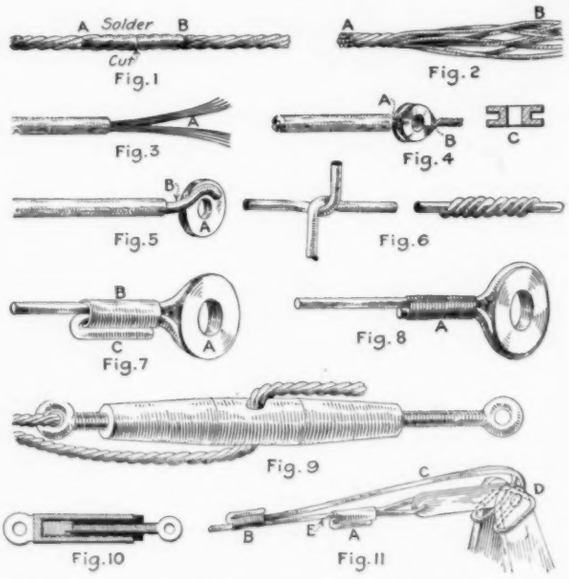
Heavier wire connections for stays and for the various controls are made as in Fig. 7. Here the end of the cable, which has been previously soldered to prevent fraying, is bent around the eye *A*; the brass sleeve *B*, which has previously been slipped on the wire, is slid down over the main wire and the end that has been bent around the eye. Sufficient room is left for the end *C* to be doubled back on the outside of the sleeve, either in the position shown or so as to form a sort of triangle over the connector. The whole thing is then carefully soldered to prevent any slipping and also to keep moisture out of the joints. The solder should extend around the eye and avoid all possibility of the rope, or cable, pulling out of position.

Another and somewhat similar method is illustrated at *A*, shown in Fig. 8, where instead of the sleeve, the two parts of the cable are tightly wrapped together with a strong iron galvanized wire known as "safety" wire and the whole thing carefully soldered. In this case no end is shown doubled back, but this form of fastening is only used when it is necessary for the rope to pass through some opening close to the eye. It is always preferable to double the end back and solder it in either case. Safety should always be the first consideration.

Turnbuckles and Safety Wires

Fig. 9 shows a form of turnbuckle that is commonly used in keeping guy wires at the proper tension. The only unusual features are the pin hole in the center and the safety wire that is run through the hole and wrapped around the body or else taken to the other eye, in order to prevent the joint buckle being turned accidentally or otherwise so as to disturb the adjustment of the tension. Another and shorter form of turnbuckle is seen in Fig. 10. Here the right- and left-hand threads telescope.

The connection shown in Fig. 11 is a form of safeguard and is largely used on all controls, such as the ailerons, or balancing wings, the elevating and depressing planes, or "flippers" as they are commonly called, and the steering rudder. The usual form of connection is illustrated at *A*. At *B* is an additional connection, carefully soldered in place on the extra wire cable *C*. This goes over and around the two controlling arms, but is not drawn taut,



SOME OF THE WORK OF AN AEROPLANE MECHANIC

as can be seen. In case of breakage of the direct wire, which is most apt to occur at *E*, the auxiliary wire *C* takes up the load and allows the machine to be handled safely, even though the control wires are somewhat slacker than under normal conditions.

These are only a few of the points to be considered, but they will give mechanics who are interested in entering the field of aviation some idea of the kind of skill and knowledge required. It is extremely interesting work, and there are likely to be many opportunities within the next few years.

A Soldering Kink

I have just run across a scheme to help in soldering. It is new to me and may be to others. As everyone knows, steel will rust after it is soldered, if not thoroughly cleaned. The scheme is to prevent this action.

Most small shops have a soldering iron and a jar of acid for odd jobs. Keep some soda water (washing soda) alongside the acid, and either dip the work into the soda or swab it off with a brush or cloth. My work is small, and I have two 8-oz. screw-topped bottles—one acid, the other soda water—both set into one block of wood.

I have been using this outfit for two months and have had no trouble with rust.

W. B. Greenleaf.

Letters from Practical Men

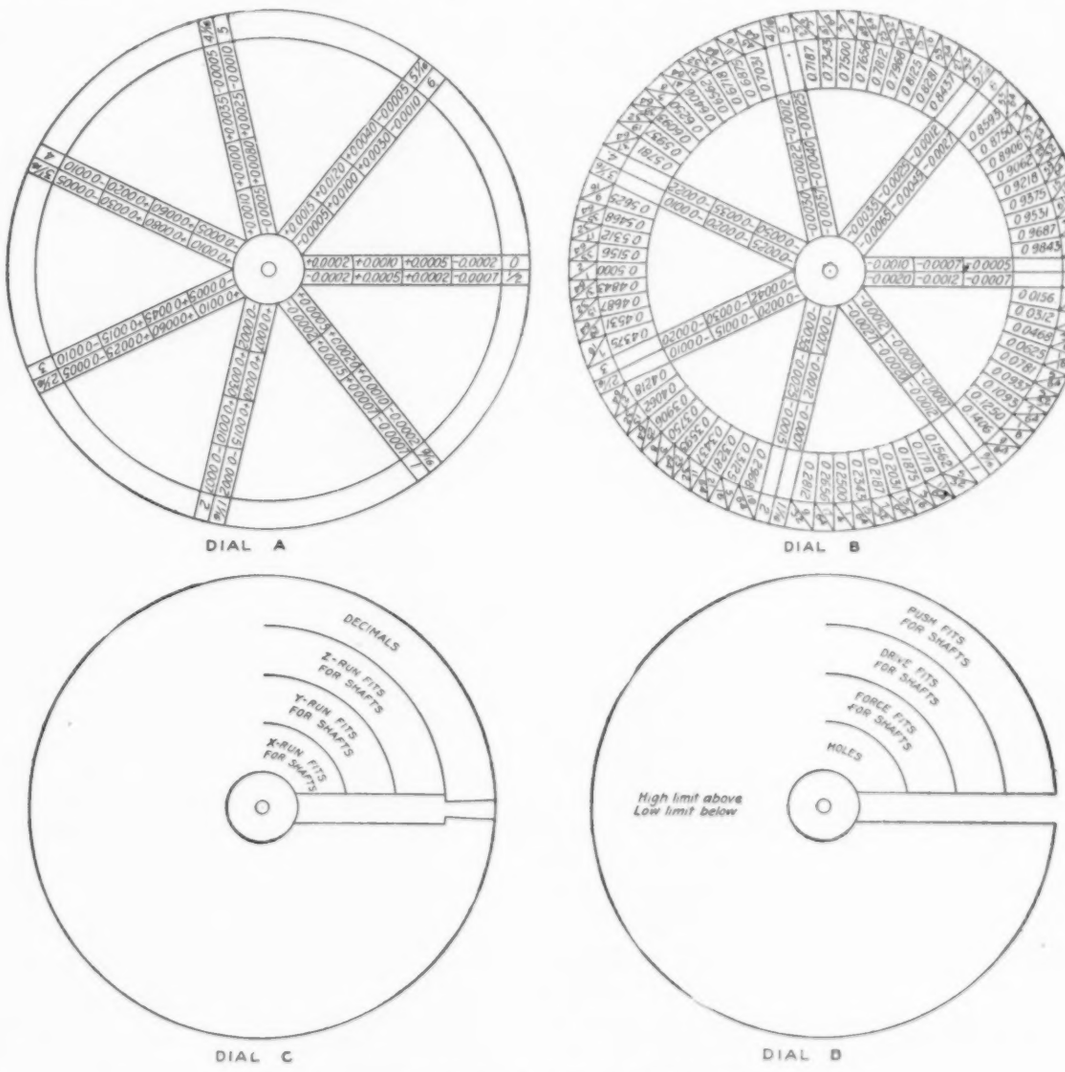
Handy Tolerance Dial

Some time ago, when I was employed on automatic machinery, I had occasion to use the tolerance table quite often. To save time, I made a table in the form shown. It is compact, as can be seen, and is very handy to have on the board.

The dial *A* is composed of tolerances for push, drive and force fits for shafts, or the male fits, and for holes, or the female fits. The dial *B* is made up of tolerances for the different grades of running fits for the shafts, or the male members, and decimal equivalents for fractions of an inch to sixty-fourths. *X* running fits, on dial *C*, are used for engine and other work where easy fits are wanted; *Y* running fits are suitable for high speeds and good average machine work; *Z* running fits are for fine tool work.

Dial *B* should be pasted on the back of dial *A*. With a sharp knife cut out the slots in the dials *C* and *D*. Punch out the small center circles and with an eyelet or paper fastener assemble the dial *D* on the dial *A* and dial *C* on dial *B*.

The method of using the dial is simple. For example, if it is desired to find the tolerances for a $1\frac{5}{8}$-in. shaft that is to run in a bearing, turn the dial *D* so that at the end of the slot, on dial *A*, is found $1\frac{1}{16}$-2. Under "Holes" on dial *D* are the high and low limits, which are in this case $\frac{+0.0007}{-0.0002}$. The diameter of the bearing would read $\frac{1.6257 \text{ in.}}{1.6248 \text{ in.}}$. For the shaft, turn to the kind of fit wanted, which is in this case a *Y* running fit. As before,



A HANDY TOLERANCE DIAL FOR VARIOUS TYPES OF FITS

with the slot at $1\frac{1}{16}$-2 under "Y Running Fit" on dial *C*, we find $\frac{-0.0012}{-0.0025}$. Therefore, the diameter of the shaft would read $\frac{1.6238 \text{ in.}}{1.6225 \text{ in.}}$.

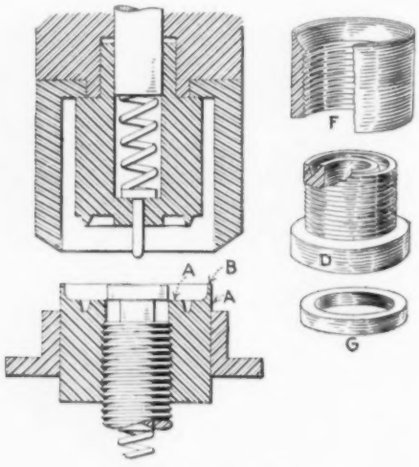
The tolerances for the other kinds of fits are derived in the same way. The tolerances for the holes are always found under "Holes," regardless of the kind of fit wanted.

Nyack, N. Y. L. C. ROBERTSON.

Reducing Cost of Tin-Cap Dies

The cost of maintenance of dies for caps that are soldered on the top of tin cans after filling can sometimes be reduced in the following manner: In Fig. 1 are shown the die and punch with the forms, etc., in place. As will be seen at *A*, the punch and forms were made all in one piece. The cutting edge, at *B*, has about $\frac{1}{16}$ in. for grinding off as the punch becomes dull. The punch *A* is thrown away when this grinding allowance is removed.

The way to overcome this waste is shown in Fig. 2 at *D*. The form is made from a suitable piece of die steel tem-



BUILT-UP CAP DIES

pered. The cutting edge is made as shown at *F*, is screwed down on *D*, ground to its proper shape and size and is used until it wears down $\frac{1}{16}$ in.

Then it is taken off, and a packing washer *G* is placed under it, screwed up tightly again and reground to size and shape. The process is kept up until the cutting edge is worn down so far that the threads do not take sufficient hold to withstand the stresses. It is then thrown away and a new cutting edge made for the same form block *D*.

Freehold, N. J. S. CRONK.

Nicking a Round File

When filing out holes with a round file, there is a tendency to push the file too far in, so that it catches on the large diameter. By grinding a nick or groove around the

NICKING A ROUND FILE

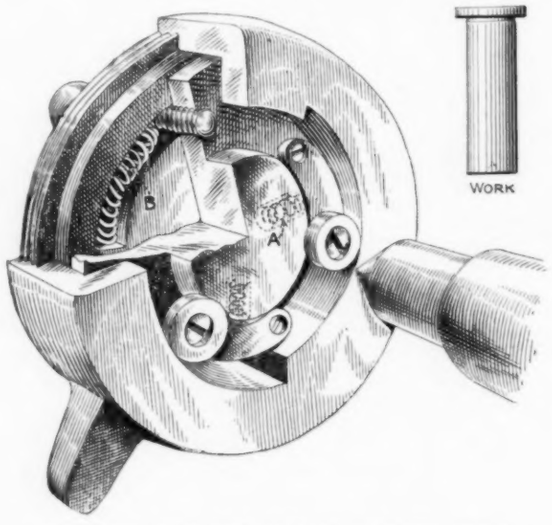
file at the point of largest diameter that will go through the hole easily, this catching is avoided, and the nick also acts as a stop. This will not only make it easier to handle the file, but it saves considerable breakage, due to an unintentional side pressure in withdrawing the file from the hole.

This method is also useful in filing a form tool, as by measuring the diameter carefully and grinding the nick at the proper point, care in filing will give a fairly accurate radius. JAMES MCINTYRE.

Bridgeport, Conn.

Grinder Dog for Tappet Studs

The tool shown has nearly doubled production on this operation. It will be seen by referring to the stud to be machined that no center could be used on the large end. The gripping is done by three rollers on a cam surface. The three springs at *A* in the light plate keep



GRINDER DOG FOR VALVE TAPPET STUD

the rollers out against the cam surface. The spring at *B* tends to rotate the rollers. Owing to the small amount of stock left for grinding—0.0009 in.—the stud had to be accurately centered in order to clean up.

Kenosha, Wis. BAXTER W. GEORGE.

Lathe and Mandrel for Roughing 4.5-In. Shell Forgings

The mandrel shown in Fig. 1 is used on heavy 30-in. lathes for rough-turning, cutting off the open end and facing the base of 4.5-in. British high-explosive shells in one operation, using four tools. The output is 10 per machine per hour.

The body of the mandrel is of soft steel well case-hardened. The driving dogs are of hardened tool steel, and the sleeve and shell collar are left soft. The mandrel is driven by the square, which fits into the driver attached to the faceplate. The cutting-off and facing tools are both carried at back on a slide *B* and are operated by a cam plate attached to the carriage, as shown in Fig. 2. This cam plate works against a roller that moves the back slide forward the proper travel to face and turn the shell. The back slide *B* is carried on a strong frame *A* that straddles the carriage and is securely fastened to the ways of the lathe, as shown.

The two tools for turning the shell are held in a casting on the regular tool slide of the carriage and are set to a gage each time after grinding. The cutting-off and facing tools at the back are set in the same manner. One important feature of this outfit is that the stresses set up by the turning tools in front are balanced by those set up by the tools at the back. This construction prevents the shell from being torn out of the center under heavy cutting stresses.

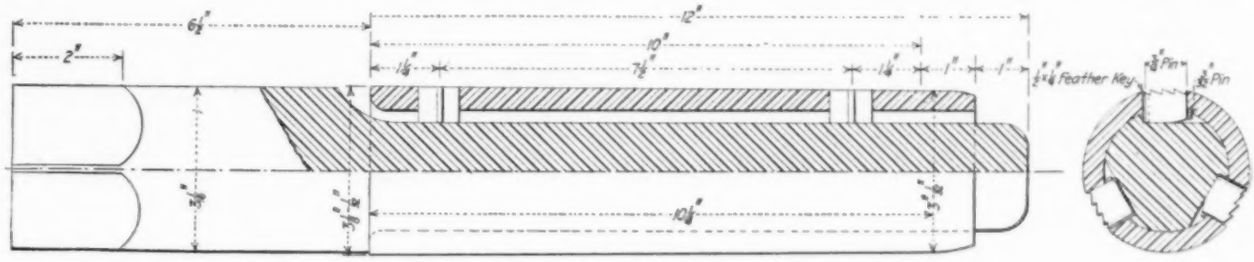


FIG. 1. MANDREL FOR HOLDING 4.5-IN. HIGH-EXPLOSIVE SHELLS

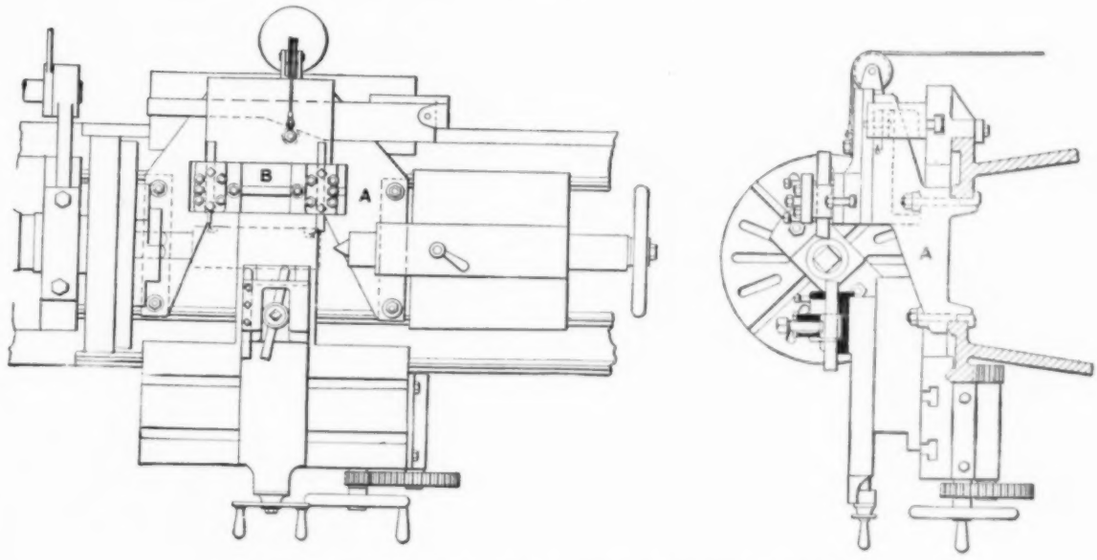


FIG. 2. DETAILS OF THE SHELL-ROUGHING LATHE

Another very important feature is using the cam arrangement for moving the back slide. There is no chance of destroying the tools or the mandrel by the operator's failing to throw off the lateral feed of the carriage at the proper moment, because as soon as the roller attached to the back tool slide arrives at the top of the incline on the cam plate, it remains stationary, as that is the limit of its travel, and the cam plate moves forward with the carriage without further moving of the back slide.

H. P. Hoag.

Brantford, Canada.

The Advantages of Machinist Draftsmen

Why do not more machinists become draftsmen? One would think it as natural and necessary for a draftsman to have been a machinist as for a teacher to have gone through the experience of being a scholar. The parallel drawn between the teacher and the draftsman is not so inapt as it at first appears. Both are instructing—conveying information. The draftsman's information to the machinist may have had many sources, but the drawing is the vehicle by which it is conveyed, just as the teacher's lessons are the vehicle by which knowledge is diffused among the students.

Yet we find, unfortunately, that much of the information given by the draftsman to the pattern maker and machinist is of an unworkable kind. We see drawings of castings that cannot be cast, other drawings of castings that can be made at great expense with the combined skill of the pattern maker and molder. I feel ashamed of my own work in this respect. So often the pattern maker has pointed out how a piece can be more simply made without sacrificing any necessary feature. I thank the pattern maker, change the drawings and wish I knew more about molding.

The blunders made by draftsmen who are not machinists are more serious than those made by the draftsmen who are not pattern makers. A good pattern maker will always tell a reasonable draftsman what changes in a drawing will make the piece easier to mold. There his responsibility ends.

After a piece has been cast and found impossible to machine, the trouble is serious. It is as easy as ever to change the drawing, but that does not change the casting. This is where the machinist draftsman shows his value. His work, considered merely as a drawing, may be lacking in some ways; his developments of curves and intersections of surfaces may be defective, but the parts he has drawn can always be machined and usually in

an easy manner. Moreover, his views will not be crowded with dimensions that are of no earthly use, and the dimensions that are there will be given from surfaces that the machinist will measure from. No matter how many years' experience a draftsman has had, he will, unless he has worked in the machine shop, give some dimensions that are not necessary and others from surfaces that cannot be reached with ordinary measuring tools and must be figured from some other surfaces by the machinist himself.

The machinist draftsman has actually built machines. He knows how important it is to avoid interferences, how much allowance should be made for fits, what dimensions should be in decimals, which surfaces to machine and which to leave unfinished, what parts should be hardened and how hard they should be. The nonmachinist draftsman either does not know these things at all or knows them only in a second-hand manner. His knowledge is confined to what he reads or to what men tell him, and the source of this information is the machinist. He is, in a manner, wearing the clothes the machinist has cast off. He can make a good picture. Granted; but the art of picture writing is not so difficult after all. The Egyptians did pretty well at that kind of writing, also the Indians. Moreover, the value of a drawing does not consist in the neatness of the work, but in the accuracy of the information.

The art of making a good mechanical drawing from information given is not difficult to acquire. The drafting work on a drawing does not call for one-tenth the skill and knowledge needed to build the machine. I should rather have on the "board" a man who has worked six years as a machinist and six months as a draftsman than one who has worked six months as a machinist and six years as a draftsman.

Leaving plain drafting and entering the field of design, the machinist draftsman has it all his own way. He can usually "see" in his mind just how the machine should be, before he puts pencil to paper. The drafting to him is only the working out of main dimensions, calculations for loads, velocities, areas and weights, the filling in of details and the arrangement of parts to avoid interference. In this field and especially in tool design the nonmachinist is so heavily handicapped that only the smartest men can hold their own. And I have found that even the clever men are left far behind in the matter of time. The man who has built machines in the shop, often without drawings, can build them in his mind at any time and place. He needs no paper and pencil except for memoranda.

Mr. Machinist, get into this field; you are needed.

Brooklyn, N. Y. F. J. Badge.

Repairing the Smoke-Stack of a Destroyer

From time to time I notice descriptions in the *American Machinist* of schemes that have been tried and proved successful in repair jobs. I recently saw an account of reforming a smashed pipe. In order to show to what extent the same scheme has been successfully carried the following experience may be of interest. In January, 1912, when the Atlantic fleet was maneuvering off the coast, a severe storm was encountered that scattered the fleet of destroyers badly. All had interesting tales to tell after the storm was over and the fleet finally reassembled at Guantanamo Bay, Cuba. During the storm No. 4 smoke-stack on the destroyer I commanded was so badly smashed that we could not use the boiler. Such a job would ordinarily have been considered beyond the capacity of a destroyer's crew.

On our arrival at Guantanamo Bay the ship was secured alongside one of the docks, and a number of old ⅝-in. bolts were obtained. The heads of these bolts were finished bright, and a row of them was soldered in the bottom of the deepest dent in the smoke-stack. An old piece of ½-in. flat iron picked up on the beach was then drilled with a series of holes spaced to fit the positions of the bolts soldered to the stack.

After this piece of iron had been slipped over the bolts, nuts were put on all, forming a makeshift arrangement for transmitting a pull to all bolts simultaneously. A strap was placed on a pile on the dock, and a double purchase was led from the strap to another one secured to the flat iron bar. Four good seamen then hauled away on the purchase, and with the blacksmith tapping the metal adjacent to the bolt heads that part of the dent was pulled out.

The bolts were unsoldered from their position and shifted to one near-by and the entire operation repeated. A templet of sheet metal was cut to the curvature of a good smoke-stack and was used as a guide to re-form the smashed one. The job was completed after a few days' work, and then the inside casing of the stack was hammered out into place by lowering men down into the stack.

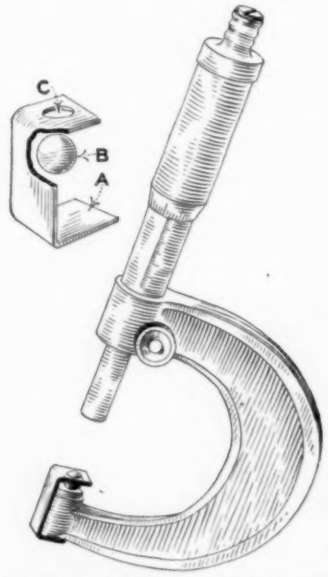
The re-forming was so neatly done that, when a coat of paint was applied, it was impossible to see that the stack had ever been injured. J. F. Hellweg,

Lieutenant-Commander, U. S. N.

Indian Head, Md.

Micrometer Ball Anvil

The illustration shows an attachment made of thin spring steel, for holding a ball on the anvil of an ordinary micrometer. If a ¼-in. ball is used, the hole in the attachment should be 0.230 in. in diameter.



BALL ANVIL MICROMETER ATTACHMENT

New Haven, Conn. Eric H. Sundkvist.

Discussion of Previous Question

Finding Surface Speeds for Machinery

Mr. Josselyn's plan on page 854, Vol. 44, relating to surface speeds for machining, is very interesting and relieves the operator of some of the trouble of figuring speeds. However, for checking by the foreman the machine must be stopped and the calculation made. This takes time and would not be satisfactory to either the foreman or the workman.

In teaching lathework I find the accompanying table very convenient and satisfactory in getting the students to use the proper speeds. This table was made large enough to be easily read 20 ft. away.

As the diameter of the work can be judged closely enough without measuring, a glance at the speed table and the machine speed tells instantly whether the speed

CUTTING SPEEDS FOR 13-IN. WILLARD LATHE

Revolutions of Lathe Spindle per Minute

Cone	First Back Gears Slow	First Back Gears Fast	Second Back Gears Slow	Second Back Gears Fast	Direct Connected Slow	Direct Connected Fast
1	32	40	90	108	265	315
2	48	56	124	150	380	460
3	68	82	176	220	535	650

Cutting Speeds in Feet per Minute, ⅛-In. Depth of Cut

	Material: Cast Iron	Soft Steel	Hard Steel	Brass
High-speed tool steel...	35	40	25	65

Revolutions per Minute for Above Cutting Speeds
(Use ⅔ of these speeds for carbon-steel tools)

	Diameter: ½	¾	1	1½	2	2½	3	4	5
Cast iron	268	178	134	89	67	53	45	33	27
Soft steel	306	203	153	102	76	61	51	38	30
Hard steel	191	127	95	63	48	38	32	24	19
Brass	497	330	258	165	124	100	83	62	50

The cutting speed is governed principally by the hardness of the metal to be turned; the kind of steel of which the turning tool is made; the shape of the tool and its heat-treatment; the feed and depth of cut; the cooling medium used, if any; the power of the machine; its design and condition. As a general rule the tool should stand up from 1 hr. to 1½ hr. before regrinding.

is right or not. The workman has no excuse for not running at the right speed, and the foreman has no difficulty in checking the speeds.

Where a number of makes of machines are used, these speed tables could be hung directly over the machines. The speeds on the table are slower than regular shop practice, but are fast enough for beginning students.

S. V. Bryant.

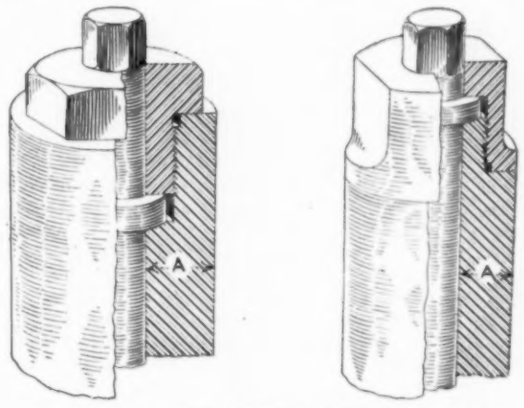
Seattle, Washington.

Best Way To Do Certain Things

In my opinion both Mr. Herz, on page 297, and Mr. Poland, page 35, Vol. 44, have missed the best way to discharge collets and cutter shanks from spindles. Taking Mr. Herz's case first and referring to the drawing on page 297, it is clear that the whole thrust to push the cutter out is taken by the point of the small setscrew that fits in the split ring. This is hardly good design.

Mr. Poland's differential-screw arrangement of the drawbolt is powerful, but crude. It also possesses the disadvantage of having the threads directly in the spindle, and these threads are subject to wear. Owing to the possibilty of getting a big pull on the cutter when drawing it up, the pressure on these threads is considerable.

Suppose now that instead of either of the methods previously submitted those shown in the sketches are studied. These arrangements are free from the objections of having small wearing surfaces or screw threads working directly in the machine spindle. The drawbolt, on being backed out of the shank, moves up against the cap or thrust nut, since the thread on this is the opposite hand to that on the drawbolt. The cap or thrust plug tends to get tighter on the main spindle, and the drawbolt



FIGS. 1 AND 2. DISCHARGING CUTTER SHANKS AND ARBORS FROM SPINDLES

pushes the cutter or shank out. Should the cutter stick, a light rap on the head of the drawbolt will always loosen it after the drawbolt has been backed up so as to exert a discharging force. This light rap may be given with the wrench used for tightening or loosening. When there is ample metal at dimension *A*, the design shown in Fig. 1 is used; when there is not much metal at *A*, Fig. 2 is used.

On set-ups where the tools have to be constantly changed, either one of these methods has conclusively proved good.

Roland V. Hutchinson.

Ironton, Ohio.

Some of the Troubles of a Small-Shop Foreman

I was interested in the remarks of Mr. Billton, on page 860, Vol. 44, on the troubles of a small-shop foreman. This is the line of talk you hear from about 75 per cent. of foremen—namely, that the management seems to take pleasure in refusing to buy things that are necessary. Now you will notice that some foremen in all shops seem to get about what they want. If you will examine those cases, you will find that those men use a great deal of tact and diplomacy when they ask for any new machine for their department, backing up their requests with logic that appeals to the "Old Man."

On the other hand, the undiplomatic foreman goes without something he needs until he has developed a good

big grouch. Then he goes at the "Old Man" with a club. If the foreman does not get what he wants he generally says, "Well, do as you —— please about it; I can stand it if you can." Most managers are human, and I have never yet found one that would not, if properly approached, grant a request or else give a perfectly satisfactory reason for not doing so.

One thing I have noticed—the "Old Man" has pretty good judgment, which is borne out by the fact that he is where he is. WILLIAM SUNDAY.

Rochester, N. Y.

Laying Out Blanking Dies

Referring to Fig. 5 of the article by W. B. Greenleaf, page 896, Vol. 44, I believe stock may be saved if the strip is simply turned over and run through the second time,

A SUGGESTION FOR SAVING STOCK

as shown herewith. It may be that the grain of the stock would render punching, as shown on the edge of this sheet, undesirable; but this point is not clear from the article. F. B. RIVES.

Hartford, Conn.

Magnetic Screwdriver

Bridgeport, from where James McIntyre writes about a magnetic screwdriver, page 729, Vol. 44, has been the birthplace of similar tools. About six months ago, while there on an outside job, the men with me made several such tools, their first being practically like Mr. McIntyre's. It did not come up to expectations. The exposed contact sometimes caused the circuit to be closed accidentally when the screwdriver lay around, and this put the battery cell out of commission. The hard-steel bit, after being magnetized, retains a certain amount of magnetism and is soon transformed into a permanent magnet. The screws

A MAGNETIC SCREWDRIVER

stick to the bits at undesirable places and at undesirable moments, causing considerable trouble and annoyance.

The men afterward made up very heavy bits and held them in a wire coil under current, tapping the bits slightly, to speed the magnetizing process. To prevent the screws from sticking to the sides of the now permanently magnetic bits, these were covered with a fiber tube, which was strengthened on the inside by a brass tube, as shown in the illustration. An iron tube on the inside proved to be a failure, as the magnetic flux then did not pass through the point of the screwdriver, but came out of the edge of the iron tube.

Taught by experience, I have personally not much use for magnetic screwdrivers and think a chunk of beeswax on the head of the screw as good as anything.

Brooklyn, N. Y. JAN SPAANDER.

Mr. McIntyre's magnetic screwdriver, on page 729, Vol. 44, reminds me of a kink that I have used where I have had difficulty in placing screws with my fingers on account of limited room. By simply drawing a common screwdriver across a magnetic chuck two or three times with the switch thrown in I have placed screws as large as $\frac{3}{8}$x1$\frac{1}{2}$ in. Of course, I placed a piece of thin cardboard on the chuck before drawing the driver across, so as not to scratch the face of the chuck.

Speaking about magnetic chucks makes me think of another kink that perhaps is not commonly known. In grinding close work sometimes a piece will come 0.0001 in. or so thin on one end. This can be remedied by making a line with a soft lead pencil under the thick end of the work on the chuck. J. C. STUART.

Hartford, Conn.

Drilling Central Crossholes in Round Bars

Will Mr. Dawson, who on page 857, Vol. 44, described a method of drilling central crossholes, tell how he overcomes the difficulty caused by the drill, when it breaks through, pushing out some little chips of metal, making it hard to withdraw the work. In a similar case both the hole and the work were badly scored.

I would suggest a slight improvement. Simply cut a groove under the hole *A* to admit a file to remove the chips, as shown in Fig. 1. This jig would be more useful

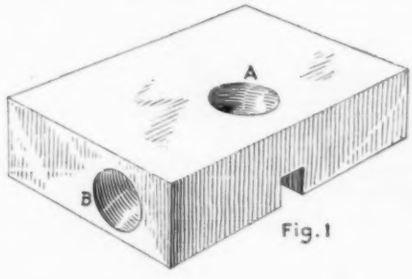


Fig. 1

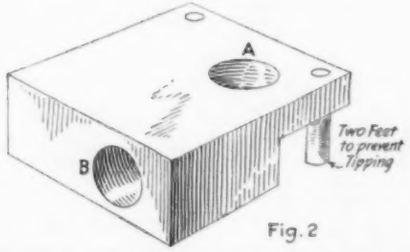


Fig. 2

IMPROVED METHOD OF DRILLING CENTRAL CROSS HOLES IN ROUND BARS

if the holes *A* and *B* were made large enough to accommodate standard slip bushings, the hole *B* to receive a bush at each end; or the jig could be made as at Fig. 2, with one bushing only, at *B*, supporting the work.

Manchester, England. FRANCIS W. SHAW.

Successful Suggestion System

I read with interest Mr. Tewksbury's article on a "Successful Suggestion System," and I would say that he owes his success with the system to the advertising that he carried on in connection with it. It is one more proof that advertising pays. He begins by saying that he has had 15 years' experience with unsuccessful suggestion systems. Would it not be of interest to the readers of the *American Machinist* to hear of some of his failures?

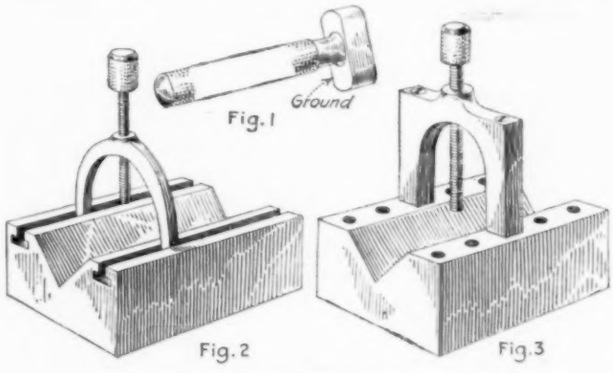
I am wondering what kind of success Mr. Tewksbury would attain if he gave a certain per cent. of the savings the employee had made instead of tokens such as watches and rings. Understanding human nature as I feel I do, I cannot see how anyone can make a suggestion that will save $6,700 in one year (Mr. Tewksbury's figures) for a firm and be satisfied when he is handed a watch or a ring for so doing.

Of course, these tokens are nice things to have, but after all it is money we most desire. The eagerness to acquire money will make a man think when everything else fails. J. C. STUART.

Hartford, Conn.

Making and Testing a V-Block

Making and testing a V-block as described by Mr. Remacle, page 717, Vol. 44, is a good method, but I would suggest a change in the design if it is to be used on precision work, as it is often desirable to grind two or more sides at the same setting—for instance, a gage like Fig. 1. This could not be ground in the block described without chang-



THE WORK AND THE TWO V-BLOCKS

ing the setting, which would give a chance for error. After discarding this kind of block we made one like Fig. 2. We then found that tightening the screw even with the fingers caused distortion enough to show an error in the work ground. So this was also discarded, and a block as shown in Fig. 3 was made. No difficulties have been experienced since. J. C. STUART.

Hartford, Conn.

Inspection of Castings

I am led to ask a few questions after reading the article by Mr. Nourse, page 648, Vol. 44. He says: "All castings must check reasonably close to the dimensions on the drawings." Having had some experience in the way that officials draw up specifications to govern the supply and inspection of materials, etc., for a government department, I have noticed how excessively fond they are of the words "reasonable" and "reasonably." In one such specification, which consisted of only three short paragraphs, the words appeared no less than eight times.

Now this may do for a government department, but I consider that such terms as "reasonably close," which are as meaningless as "dead accurate," could be eliminated with advantage from the vocabulary of a live inspection department. If not, then we need not go to the trouble of fixing limits on any of the work. We can simply figure up, say, a shaft as being 1¼ in. in diameter "reasonably close"!

We have, however, been brought to see that a variation may exist between pieces of work without being detrimental to the function of the pieces, and these variations are now expressed in definite terms. This being so, why not express in the same definite terms the variations that may exist in castings?

The great drawback to "reasonably close" as a definition is that it will vary very largely according to the health, temper or environment of the individual inspector. Therefore it is not a standard. My advice is to drop "reasonably close" and come to some agreement as to the allowable limits and fix these on the drawings. If this is done, then the inspection of either rough castings or finished work will be put upon a scientific basis.

Guildford, England. WALTER G. GROOCOCK.

Blueprints Without Tracing

On page 960, Vol. 44, Mr. Sharkey mentions the disadvantages of drawings made with a soft pencil on thin bond paper. Such drawings are satisfactory for blueprinting and are frequently called for when the drawing is considered to be of only temporary value. However, all such drawings should be carefully preserved and may come into use many times. For this reason it is well to render them permanent by treating the penciled surface with "fixatif" such as is used by crayon artists. This can be purchased at any store handling artists' materials and is applied with an atomizer. One with a mouthpiece is much preferable to those having a bulb, as the latter are liable to become stopped after considerable service. The application of "fixatif" overcomes all the objections cited by Mr. Sharkey. A slight amount only is required, a few drops being sufficient for treating a large drawing. If the commercial "fixatif" is not available, denatured alcohol with a little shellac dissolved in it will be found to be a satisfactory substitute.

On pencil drawings it is the dimensions that are most easily obliterated or rendered uncertain. These should in all cases be made in ink, to secure permanence. It is well also to make the witness marks in ink to insure a correct interpretation of the dimension figures.

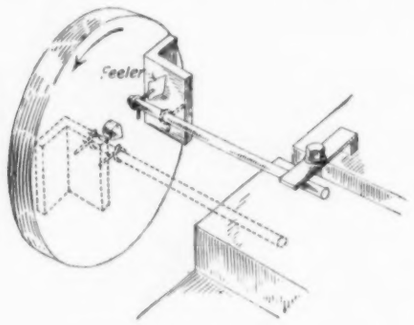
Letter-size pads of thin bond paper are convenient for small drawings and for sketches such as are required for repair jobs, simple tools or minor alterations to the plant. On such pads a suitable printed title blank costs but a trifle. It not only adds to the appearance of prints that are sent outside the factory, but is of value in properly indexing the sketches for future reference. In making such pencil sketches it will be found that a large part of the work will be done freehand and the services of a draftsman, in many cases, will be entirely unnecessary.

Barberton, Ohio. FRED B. COREY.

Setting Angle Plates

On page 884, Vol. 44, is shown a method used in small shops for setting angle plates square with the axis of the lathe. But true mandrels or arbors are rare in some shops, and other means must be resorted to.

Fig. 1 shows how to set an angle plate true on a faceplate of an engine lathe. The position can be anything from zero to maximum. All that is required is a boring



SETTING ANGLE PLATES

bar with a piece of wire, or anything inserted that will not scratch or cut the angle plate.

The angle plate is bolted in approximate position. The boring bar is brought to touch at the front and rear. The faceplate is then rotated one-half revolution, the cross-slide moved forward and tried at opposite points. A paper feeler should be used. The angle plate should be counterbalanced during truing, but this is not shown, for the sake of clearness. G. Strom.

Brooklyn, N. Y.

Design of Holding Jaws

In answer to Mr. Beuter's article on page 1002, Vol. 44, in regard to "hold-downs" I will give the benefit of my experience, as I have used both kinds.

In practice, unless the angle on the contact surfaces is too great, the difference in the holding or downward action of the two styles is so small that it would be hard to tell which is better.

I always preferred the one illustrated in Fig. 1, with the angle on the jaw side only, as there is always a possible chance of the one in Fig. 2 sliding under the work and raising it slightly before the downward movement is started. Of course, if the hold-downs are blocked up so that they do not grip the piece at the bottom, this objection is overcome. Harold E. Greene.

Ilion, N. Y.

Side Shields for Emery Wheels

I have read with interest Mr. Jacobs' answer on page 780, Vol. 44, to my letter, which appeared on page 606, about grinding on the side of an ordinary wheel, and I am glad to see someone at last give a reason for not using the side of a wheel.

Of course, it is very true that, if the speed is right for the edge, it will not be the best speed for the side. In manufacturing where the grinder is being used all day on the same kind of work, it would be foolish to use the side of an ordinary wheel where a cup wheel or a disk would be better.

In using an ordinary grinder, however, either in the toolroom or job shop, convenience outweighs speed of actual grinding. Easily two-thirds of the time of the grinder is taken up in grinding lathe and shaper tools. A man who sharpens a tool will spend probably 90 per cent. of his time in removing and resetting his tool, walking back and forth, and waiting his turn at the wheel. When he is actually at the wheel, he will give half his time to looking at the tool to see if the shape is right and in cooling it, so that the percentage of time devoted to removing metal is very small and the efficiency, within pretty wide limits, is of no consequence. On the other hand, he can more easily get the shape he wants and more readily see what he is doing if he is free to use both the side and the edge of the wheel.

Even if there were an ordinary wheel running at its best speed and a cup wheel 3 ft. away, also running right, I believe I should stick to one or the other and save time doing it in grinding a lathe tool.

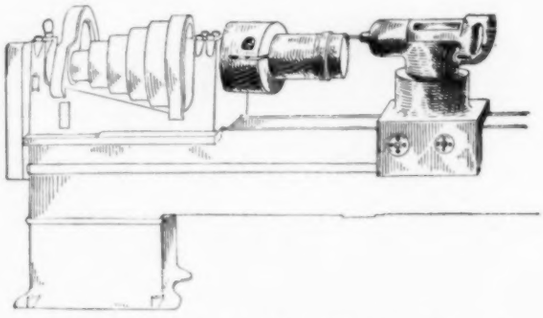
Of course, under these ideal conditions if I had a small die to grind I should go to the cup wheel. But if the cup was in use, it would be quicker to use the side of the ordinary wheel than to wait.

As a matter of fact, however, these ideal conditions do not exist in the job shop or toolroom. The new wheel is usually 8 to 12 in. and is allowed to stay on the machine until it is not much larger than the flanges. The men are lucky if the speed is right, for either the edge or side, at any point of the wearing-down process, and it is just about as apt to be right for one as the other.

Plymouth, Mich. W. B. Greenleaf.

Increasing Base Diameters of Shells

The illustration shows a pneumatic hammer mounted in a special carriage of a lathe and used for upsetting the bases of shells that have been turned too small. One shell



INCREASING BASE DIAMETERS OF SHELLS

shop, where there were a number of undersize shells, is reclaiming them in this way. Shells as much as 0.005 too small are upset to size and cleaned with a file.

Chicago, Ill. W. Davis.

The Iron-Ore Production of the United States in 1915 reached a total of 55,526,490 tons, according to the figures collected for the United States Geological Survey and prepared by E. F. Burchard. This was an increase of about 14,000,000 tons over 1914 and was a larger production than in any previous year except 1910 and 1913. The average value at mine, as computed by the Survey, was $1.83 per ton in 1915 against $1.81 in 1914.

Editorials

Run Up the Flag

Recently an editor of the *American Machinist* while visiting a shop in New England inquired of the owner what he intended to erect as the next addition to his plant. He replied, "A flagpole." Sure enough he had ordered a spiral riveted steel pole and was anxiously awaiting its arrival so that he might erect it and run up the Stars and Stripes.

To most American manufacturers—a few there are undoubtedly who are beyond the power of being influenced by anything save money or self-advancement—the American flag is a symbol whose presence cannot fail to influence toward the development of best ideals. It is the patriotic shop owners, however, who form the bulwark of industrial defense, and from what the *American Machinist* has observed during the last year or two this bulwark in time of need would indeed be a strong one.

One of the regrettable things about our large cities, and possibly New York in particular, is the absence of our country's flag. Here are hundreds of tall buildings, surmounted by hundreds of tall flagstaffs, most of which seem to have been placed there for no evident purpose. It is rare, except on special holidays, to be able to count two dozen flags over the business heart of New York City.

Possibly this is owing to carelessness, or rather thoughtlessness. Let us think so at any rate. Then, again, it may be because of a lack of organization or "preparedness" that includes in someone's daily routine the task of putting up the flag. American machine shops, however, are places where routine is a matter of course, and in every shop there is a man with enough time to spare for this daily pleasant duty. All that may be lacking is the flag and its staff, and unlike the delayed deliveries on machine tools, there has been no such excessive demand for these articles as to prevent one from getting either of them at once.

It is a good thing to "hitch your wagon to a star," but it is a still better thing for American manufacturers to hitch their shops to the Stars and Stripes. Get busy and see that the new addition to your shop is erected at once, and that the good old flag goes up to stay.

⁂

The Metric System--Compulsion and Propaganda

In a recent letter a correspondent asked the *American Machinist* to define its position clearly in regard to the metric system of weights and measures. We had not realized that there was any possibility of misunderstanding or misinterpreting the comments in these columns that have dealt with some of the phases of the metric propaganda and proposed metric legislation. On the contrary, we believed that our utterances were so plain spoken that their meaning was unmistakable. However, if one reader has been at a loss in trying to comprehend our position, another attempt must be made to clear up the situation.

The *American Machinist* is not opposed to the metric system. It has the same legality as the older English system of weights and measures. Anyone who wishes to use it in preference to another has this full right, and to this right there can be no objection.

But the *American Machinist* is opposed to each and every effort that tries to make the metric system compulsory and exclusive throughout the United States. The *American Machinist* is also opposed to the active prometric propaganda that seeks to overthrow our present English system. This effort at education is really an effort to injure and hamper American industry. Stated somewhat more affirmatively, the *American Machinist* believes in the maintenance and improvement of our present system of weights and measures, knowing that this will bring nothing but good to the industry and commerce of our great country. We also believe that the public should be educated in regard to the importance of the subject of our weights and measures. We believe further that sane legislation should be promoted seeking to conserve our basic English units.

There is no question as to where the interests of the manufacturer lie. In fact, the metric controversy in this country can be said to be between men who measure in order to produce articles from raw materials and those who measure existing things in order to make a record of dimensions. It is a conflict between the engineer and manufacturer on the one hand and the scientist and pseudo-scientist on the other.

⁂

On a Naval Repair Ship

It is believed that the first voyage ever made by a technical correspondent on a United States naval vessel has recently been completed by Frank A. Stanley for the *American Machinist*. His first article is in this issue. This journey on a floating machine shop began at the Mare Island navy yard, California, and ended at New York. The kindness of Navy Department officials and navy officers made this trip possible and afforded means of studying at first hand how machine tools act when set on the moving deck of a vessel at sea, and the nature of emergency repairs to naval equipment.

The machine-tool designer always thinks of his finished machine as set up on a rigid floor or substantial foundation, carefully aligned and leveled, and given all the advantages of a fixed position when called upon to do accurate work. It probably never occurs to him that a machine tool may be set on the pitching, rolling deck of a vessel and be required to do good work under such conditions. It is possible that if those unusual surroundings were fully understood there might be modifications in design from those that are now common.

To be sure, not many machine tools are bought for use at sea. However, it is not uncommon for a manufacturer to point with pride to the fact that his particular product

has been selected for such service. It is therefore justifiable to present the query, What steps have manufacturers taken to adapt their machines for use on naval repair ships and for similar purposes?

What is the angle of repose of the slides of machine tools as ordinarily designed and tightened? Will they move of themselves if tipped at an angle of 15 deg. or more or less? How nearly accurate holes will a lathe or boring mill bore when it is being pitched about on a deck in a heavy sea? Are machine tools strong enough to resist the inertia strains brought upon them if thrown about when at work? Are the ordinary fastening devices for work substantial enough in design and ample in number to withstand the inertia forces set up on shipboard?

In future articles Mr. Stanley will attempt to answer some of these questions.

What Makes an Engineer?

At the recent Virginia meeting of the Society for the Promotion of Engineering Education, Dr. C. L. Mann, of the Carnegie Foundation, made a preliminary report for the Joint Committee on Engineering Education. A digest of part of this report appears in this issue, taking up the statistical summary of replies to a questionnaire on the reasons for engineering success.

The figures given in this preliminary statement are well worthy of study, for on a percentage basis they rate character at 24, judgment, 19.5; efficiency, 16.5; understanding of men, 15; knowledge of fundamentals, 15; and technique, 10. That is, the purely technical equipment of the trained engineer is placed at only 25 per cent. of the necessary qualifications for his success. The other 75 per cent. includes those qualities of mind and character that are the possession of every truly successful man.

This does not, however, imply that a 100 per cent. possession of the mentioned characteristics of mind and moral nature will make a successful engineer. It does rather mean that a 100 per cent. possession of those characteristics is 75 per cent. of the engineer's needful equipment. The other 25 per cent., including the specific knowledge of his profession, is of course as essential as the others. But a 100 per cent. rating in the latter forms only 25 per cent. of the necessary equipment for success in engineering work. Turning now to other features of the report, the dominant elements are as follows:

1. The present system of engineering education is a development based upon the industrial progress and the industrial needs of the country.

2. Just as industry is progressing from a stage where material equipment marked the highest degree of excellence to the present stage in which the human element in production takes a dominant part, so it is true that the demand for the best results in engineering makes necessary the development of the human element in those who practice.

3. The school records of men graduated recently from representative institutions indicate mediocre attainment in the fundamental subjects, although their subsequent work in practice may be counted upon as being reasonably good. Whether this means poorly taught subjects or the relative unimportance of a knowledge of engineering fundamentals does not appear.

4. There are indications that the schools give major attention to the training of students in engineering science, to the exclusion of training in other characteristics that are greatly involved in the successful man's career. In this comes the great constructive problem as to how the schools may develop methods that will result in a more adequate preparation for professional work, but beyond indicating the character of the problems the investigation as conducted cannot go.

At a later date a final report will be made, and it is hoped that the knowledge gained from the investigation can be put into practical use in the engineering schools. Obviously it is to the advantage of technical educators to know just what is wanted in mental and moral equipment to make a successful engineer before trying to direct a school to meet those wants. Let us hope that one result of the study will be to modify technical educational methods so that future cadet engineers will not be tied and gagged by the precedents of what they have been taught.

Making Shells with Regular Shop Equipment

While it is undoubtedly true that special single-purpose machinery affords the most economical methods of manufacturing if the quantity be sufficient to warrant such an installation, there are comparatively few shops that manufacture in this way. And it is probably well that this is the case. The average shop, with its more or less standard equipment, gives a flexibility as to the goods that can be manufactured, which has many advantages. This feature is especially desirable in such emergency manufacturing as the making of shells and similar munitions.

The ability to adapt the standard machines already in a shop so that they can make a new product at a low cost is of great importance and shows a high grade of practical mechanical knowledge. Such a possibility is particularly valuable in emergencies like the making of shells and other munitions of war, as hundreds of small shops are thus able to begin work promptly and to secure a constant flow of munitions with little delay. It is for this reason that we consider the methods described on page 1077, Vol. 44, of special significance.

It is believed this article will prove helpful in shops of all sizes not equipped with special machines, and few will be after present war contracts are filled. A careful study of these methods may well be a part of the preparedness program of small shops in all sections of the country.

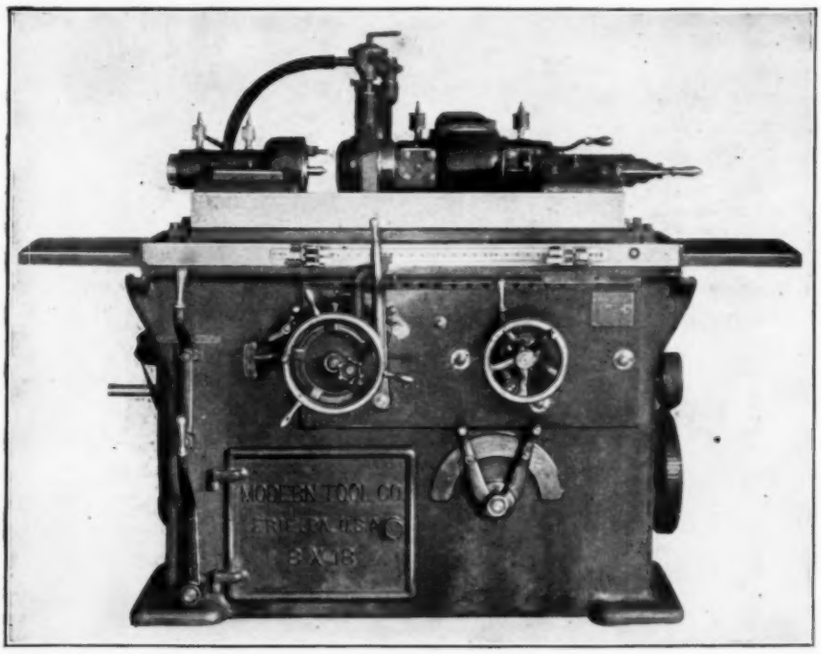
The prediction of the preparedists that in case of war in this country there will be a great scramble for material seems to be coming true. Emergency specifications are being sent out and bids demanded almost at once. Some of those that have interested machine-tool and small-tool builders have called for large quantities of engineering material including hardware, entrenching tools, surveying and drawing instruments and the like, and also 36 complete motor-truck machine shops. The latter is of interest to men in the shop, for it purports to be a complete list of everything needed for a small repair shop. Its extent can be imagined from the fact that the equipment specifications alone cover 5½ pages of legal-size paper including 103 items.

Shop Equipment News

Self-Contained Grinder

The illustration represents a recent addition to the line of self-contained grinders manufactured by the Modern Tool Co., Erie, Penn. In addition to the size shown, the machine is made in an 8x30-in. size.

The bed is a one-piece casting, braced to insure stability. It is of compact design, and the units are so located as to be easily accessible. To maintain alignment of parts, V and flat guides are used throughout, on the sliding table, swivel table and under the wheel stand. The base rests upon three points, designed to prevent cross-strain, preserve the alignment and provide for irregularities in flooring.



SELF-CONTAINED CYLINDRICAL GRINDER

Size, 8x18 in.; wheel spindle, 2¼ in. in diameter; driving belt, 4 in. wide; eight work speeds, 26 to 390 r.p.m.; four table feeds, 22 to 104 in. per min.

The wheel-stand pile is bolted to the bed of the machine and is of heavy proportions. The wheel stand is held in place by gravity, but is provided with a safety gib to guard against danger of lifting under abnormal conditions. The wheel center is of large diameter, has a long bearing on the spindle and will take any of the recognized standard grinding wheels.

The table slide is of heavy proportions and ribbed to resist torsional strains. The swivel table has a large bearing on the table slide and pivots on a large central stud. The table provides for grinding tapers and is graduated to read taper per foot in inches. The table drive is of a simplified type, eliminating what was formerly known as the table transmission. This table drive consists of a single unit, contained in the bed of the machine, which is a combination of table drive and transmission. All-steel spur gears are used for the reversing mechanism. The power table traverse is controlled by a lever immediately at the left of the table handwheel, which provides for starting or stopping the table at any point in its stroke. When the table is under power, the handwheel is automatically disengaged. When power is removed, the handwheel is automatically engaged for traversing the table by hand. There are four table feeds, derived from a single-unit gear box and controlled by a lever at the right immediately below the table handwheel.

The automatic crossfeed is positive in its action and is simplified without losing any of its features. It can be set for a reduction of any amount from 0.0005 in. to 0.005 in. at either or both ends of the table reverse. This latter feature is especially advantageous when grinding against a shoulder. The feed is automatically thrown out when the work is ground to size, and a positive stop is provided for feeding by hand. The crossfeed handwheel is graduated in 0.0005-in. divisions in plain view of the operator. Adjustment of the crossfeed is made by the movement of a lever to the amount of feed desired, as indicated on a graduated dial plate, and may be instantly changed to any feed while the machine is in operation.

The headstock is driven from a shaft under the sliding table. This shaft is driven by a pulley, which is carried in a bracket on the bed, on which the power is taken from the gear box. The shaft under the table is splined its full length for the ball driver, which is contained in the pulley mounted on the bed. These balls not only drive the shaft, but are also designed to reduce the friction in the traversing movement. The headstock is driven from this shaft by a belt that runs over an idler pulley and gives a large surface of contact to the headstock pulley. The belt drive is designed to provide a smooth movement to the work and to eliminate chatter. The headstock is fitted to the swivel table by means of V and flat ways and is held in position by clamp bolts. The headstock spindle is hardened and ground and runs in bronze bearings adjustable to wear. It is lubricated by means of sight-feed oilers.

A feature of the headstock is the combination of live and dead centers. The spindle is carried in bearings in the headstock base, in which it revolves for live-center work. The faceplate is clamped to the spindle, and the spindle revolves in the headstock bearing for live-center work. To change for dead-center work, it is only necessary to loosen a screw that clamps the face-

plate to the spindle and tighten the clamp on the headstock, which holds the spindle firmly in the headstock base. The dead-center pulley is then free to revolve upon its bearing for dead-center work.

The footstock is fitted to the swivel table and preserves its alignment in the same manner as the headstock. The footstock spindle is held in any position by a spring, or it may be set positive against the work and locked. The work centers on the headstock and footstock are directly over and between the guides of the table.

The wheel-truing device is mounted on the footstock and is adjustable to all diameters within the range of the machine, so that the wheel can be trued without removing the work from the centers. All work speed and table feeds are controlled by levers on the front of the machines and are derived from a separate-unit gear box that in addition to occupying a small space is so located as to be easily and readily inspected.

Vertical Continuous Millers

The illustrations show two continuous millers recently developed by the Becker Milling Machine Co., Hyde Park, Boston, Mass. In general these machines follow the design and construction of the high-powered continuous miller built by the same concern, which was described in detail on page 1101, Vol. 41

The single-spindle machine shown in Fig. 1 is exceptionally heavy and is designed for the production of large work at high speeds. The two-spindle machine is used for the continuous milling of such work as connecting-rods for gas engines. The work is mounted in

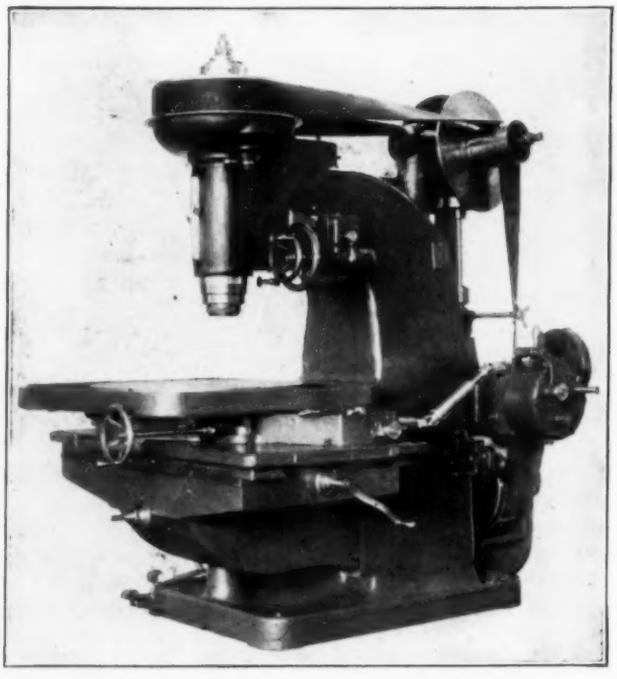


FIG. 1. HEAVY CONTINUOUS MILLER

Table diameter, 40 in.; one central T-slot and three at right angles to it; driving pulley, 25 in. in diameter; height overall, 100 in.; floor space, front to back, 93 in.; length, 118 in.

suitable fixtures on the rotary table, which is off center from the spindle. Each spindle carries a pair of straddle cutters properly spaced to straddle-mill the wristpin and crank ends respectively of the connecting-rods. The work is of course placed and removed while the table is in motion. With a proper equipment of accurate jigs, highly accurate work can be produced. The production time varies between comparatively wide limits, small pieces being finished as quickly as they can be placed and removed by the operator.

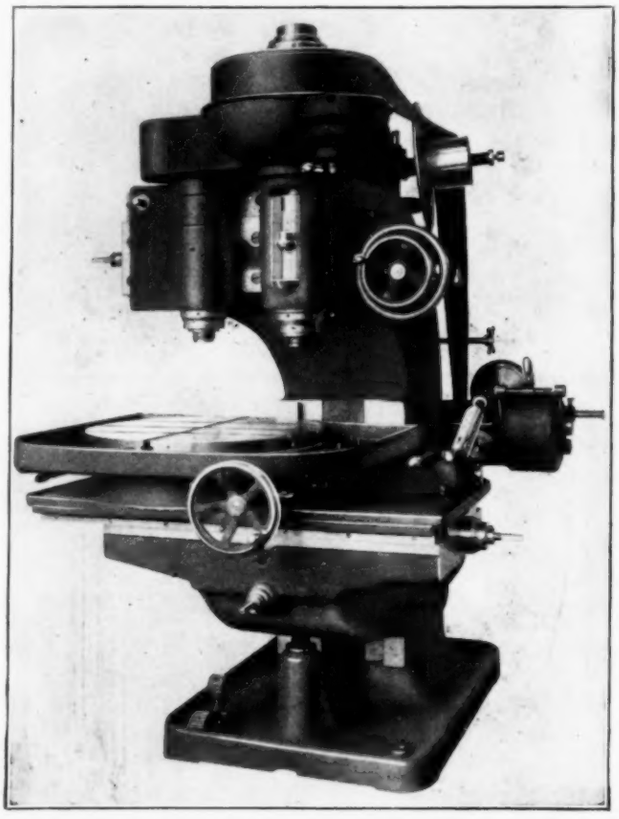


FIG. 2. SPECIAL CONTINUOUS MILLER

Table diameter, 29¾ in.; one central T-slot and three at right angles to it; driving pulley, 20 in.; spindles center to center, 8½ in. minimum, 18 in. maximum; height overall, 90 in.; floor space, 91¾ in. front to back; length, 77½ in.

Gas-Fire Pot

The gas-fire pot shown is a recent product of the Tirrill Gas Machine Lighting Co., 103 Park Ave., New York City, and is large enough to accommodate two soldering

GAS-FIRE POT

coppers, weighing 6 lb. each, while the pot is equally well adapted for the smaller-size coppers.

The pot can be operated on all kinds and grades of gas, with or without valves. It may be used as an atmos-

pheric burner or under air pressure, from a blower or other air supply. The whole pot is constructed of cast iron with a heavy sheet-iron outer jacket. The intensity of the heat is under minute control through a Rose heating burner.

Bench Drilling Machine

The design and construction of this bench drilling machine are made apparent by the illustration. While designed primarily for tool and experimental work, the

BENCH DRILLING MACHINE

Distance of spindle to table, 8¼ in.; movement of spindle, 3¾ in.; movement of table, 4 in.; diameter of table, 7¼ in.; swing, 9¾ in.; capacity, ⅜ in.; speed, 1,500 to 5,000 r.p.m.; height, 26 in.; weight, 48 lb.

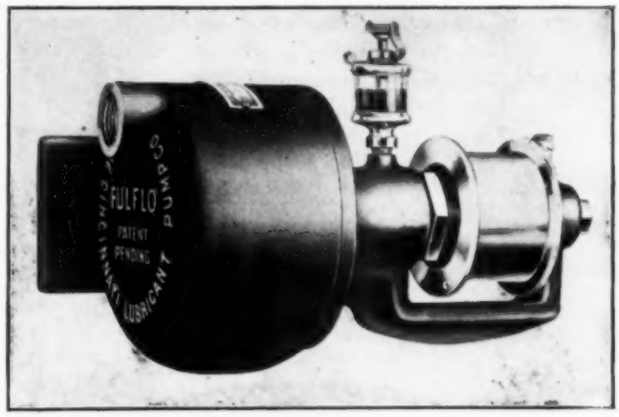
machine is believed to be suitable for a variety of light manufacturing operations. The machine is made by the Enterprise Machinery Co., Chicago, Ill.

Grinder Pump

The grinder circulating pump shown is centrifugal in action. Although smaller than the submerged fan type of pump commonly applied to grinders, it is claimed to deliver a greater volume.

It may be mounted above the level of the liquid and because of its positive trap arrangement will retain its prime without the aid of a check valve or other working parts. This form of pump has no bearings in the pump proper. The impeller, the only working part in the pump, is mounted on the driveshaft. The absence of gears or other close-fitting parts renders harmless the grit and dirt present in the grinding fluid.

The driveshaft is hardened and ground, running in bearings on both sides of the drive pulley. The outer bearing, which also takes care of the end thrust, is of phosphor bronze. The inner bearing, which is combined with the stuffing-box gland, is of cast iron. This inner bearing is protected from the emery grit and dirt by the



GRINDER CIRCULATING PUMP

Capacity: Flow per minute at pulley speed of 1,200 r.p.m., 5 gal.; at 1,400 r.p.m., 10 gal.; at 1,600 r.p.m., 15 gal.

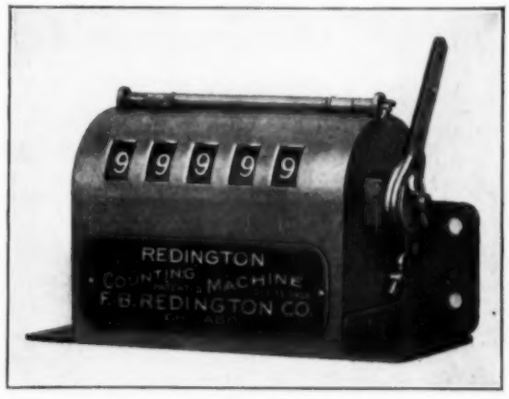
ample use of a combination of metallic, graphite, rubber and flax packing.

The pump shown is a recent product of the Cincinnati Lubricant Pump Co., Cincinnati, Ohio.

Counting Machine

The form of counter shown was designed for application to all classes of machinery. It is of all-steel construction, with large bearing surfaces. As the parts are made from sheet steel formed by dies, interchangeability is assured.

The machine has large plain figures, the feed of which is such that they cannot jump or repeat and can



MACHINE COUNTER

be readily set back to zero. The figures move an entire space on the downstroke of the lever, thus eliminating any confusion that might arise in reading the counter while the machine is in operation.

The counter is finished in black and copper and is a recent product of the F. B. Redington Co., Chicago, Ill.

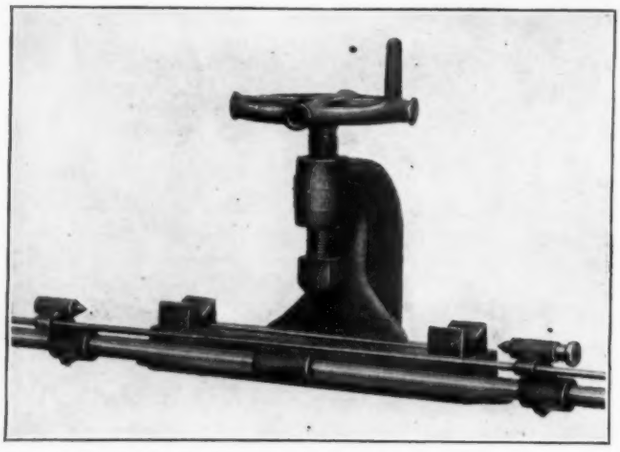
Bench Straightening Press

The V-blocks of the straightening machine shown are adjustable on a planed surface. By using pieces of copper in the blocks and under the screw head, tools and finished work are rapidly and easily straightened.

The base is one solid casting heavily ribbed and braced. The screw is of steel, with square-thread, five-pitch. The nut is 4½ in. long, tapped in the solid cast-

ing. The handwheel has four cored openings to receive a ⅞-in. steel bar for applying the pressure. A steel collar is placed between the shoulder of the screw and the head piece to reduce the friction.

The heads are adjustable on a polished shaft, having a keyway to keep them in line. One of the centers springs



BENCH STRAIGHTENING MACHINE

Capacity for stock up to 2½ in. in diameter, 48 in. long; base, 16 in. wide, 28 in. long; screw, 1½ in.; handwheel, 12 in. in diameter

back far enough to receive the stock without changing the head. A convenient rod is attached, as shown, for resting the hand while chalking the work.

The machine is made by the John T. Towsley Manufacturing Co., Cincinnati, Ohio.

Characteristics for Success in Engineering

Last March the Joint Committee on Engineering Education, acting under the auspices of the Carnegie Foundation for the Advancement of Teaching, sent to the members of the national engineering societies the following card:

Please prefix numbers to the groups of qualities listed below to show the order of importance that you give them in judging the reasons for engineering success or in sizing up young men for employment or promotion:

...Character, integrity, responsibility, resourcefulness, initiative.
...Judgment, commonsense, scientific attitude, perspective.
...Efficiency, thoroughness, accuracy, industry.
...Understanding of men, executive ability.
...Knowledge of the fundamentals of engineering science.
...Technique of practice and of business.

Submitted by.....
Address .....
Years in practice...

Up to the first of June 6,773 of these cards had been returned; 352 were accompanied by letters explaining the views of the writers. A statistical summary of the returns was begun on May 1, when 6,069 cards had come in. Of these, 5,441 were regular, each one rating the six groups in the order of importance by some single combination of the numbers 1 to 6. There were 489 irregular cards, in which one or more of the numbers appeared more than once or in which the qualities were weighted by percentages instead of being numbered. On 139 cards, the qualities were numbered in two or more different orders—one for engineering success, another for employment, etc. The regular cards were sorted according to the number of years in practice and the vote counted separately for each five-year period. Cards on which the years in practice were not given were counted together.

Differences in years of practice were found to make but little difference in the vote. The following table gives the regular vote by ten-year periods. The table reads: Character was rated higher than judgment by 84.8 per cent. of the voters who had less than ten years of experience, by 86.3 per cent. of those with from 10 to 19 years of experience, etc. The last column gives the percentage vote on each item for all the 5,441 voters.

	Years in Practice				
	Under 10	10 to 19	Over 20	Not Given	Total
	Number of Ratings				
	1,000	2,000	1,941	500	5,441
Initial Letters of Group	Percentage Vote	Percentage Vote	Percentage Vote	Percentage Vote	Percentage Assembled Vote
C > J	84.8	86.3	88.6	88.2	87.0
C > E	92.5	92.5	92.8	91.8	92.5
C > U	92.7	93.0	95.0	95.8	93.9
C > K	91.8	91.0	91.9	91.4	91.5
C > T	97.3	98.0	98.0	98.0	97.9
J > E	77.8	78.7	76.3	75.4	77.4
J > U	80.8	82.1	84.1	82.0	82.5
J > K	78.4	79.7	74.7	75.8	77.4
J > T	96.8	96.2	95.0	96.2	95.9
E > U	59.7	61.5	68.5	65.4	64.0
E > K	65.0	63.0	64.9	64.4	64.2
E > T	93.9	92.9	92.7	95.8	93.4
U > K	57.7	57.3	54.5	52.2	55.9
U > T	89.9	87.1	85.7	86.0	87.0
K > T	92.3	90.3	90.7	91.2	90.9

The most probable values of the relative importance of these groups of qualities have been computed from these percentage votes by the method described in Chapter VIII of Thorndike's "Theory of Mental and Social Measurements." These values are given in the first column of figures. The last column gives these same values as determined by the summary of the replies to the first circular letter, explained in *Engineering Record* for Jan. 29 and *Engineering News* for Jan. 27, 1916.

Character	24.0		41.0	
Judgment	19.5		17.5	
Efficiency	16.5		14.5	
Understanding of men	15.0		14.0	
		75		87
Knowledge of fundamentals	15.0		7.0	
Technique	10.0		6.0	
		25		13
		100		100

Because of the constancy of the percentage of the votes, as shown in the table, it is clear that this statement of the factors essential to engineering success corresponds to a rather definite ideal in the professional mind. It is therefore safe to make use of this definition in testing and planning the work of the schools.

When applying this definition to the schools, it is desirable not to forget several perfectly obvious facts. In the first place, all the qualities mentioned are essential to genuine success, and conscious effort should be made to develop all of them as far as is possible. Second, character, initiative, commonsense and qualities of this sort cannot be taught explicitly like multiplication tables and rules of grammar. Third, education is a continuous process of growth, and therefore the conscious development of the qualities of the first four groups cannot to advantage be arrested for four years, even for the sake of a mastery of knowledge and technique. Fourth, the man whose character, judgment, efficiency and understanding of men have developed most during his college years has the best show after graduation, since these

qualities constitute 75 per cent. of his equipment. Fifth, the fact that character is rated at 24 per cent. does not mean that an engineer can succeed with a 24 per cent. character. It does mean that even a perfect character is but 24 per cent. of the engineer's total equipment.

With these facts in mind, it is evident that instruction in mathematics or machine design that aims only at a mastery of fundamental principles and technique cannot be nearly as efficient as instruction which, while paying due regard to technique and the mastery of principles, yet develops integrity, initiative, resourcefulness and commonsense.

NEW PUBLICATIONS

VALVES AND VALVE GEARS—By Franklin de Ronde Furman. Second edition. Two hundred and fifty-three 6x9-in. pages; 237 illustrations; indexed; cloth bound. John Wiley & Sons, Inc., New York City. Price, $2.50.

This book, when first issued two years ago, referred chiefly to steam engines. In the present edition the first volume treats of valve mechanism applied to steam engines and turbines. A second volume (in preparation) will cover internal-combustion engine valve gears. The present volume should be adapted to the work of instruction, because of the large number of problems and exercises given. The usual forms of slide, riding-cutoff, Corliss and other four-valve gears are adequately described. A feature of the book is the complete treatment given to poppet, uniflow-engine and steam-turbine valve gears. The treatment of turbine gears includes a description of the De Laval mechanism, the hydraulic, steam-actuated and mechanical valve gear used on the Curtiss turbine and the direct, hydraulic or oil-operated relay and steam-operated relay used on the Westinghouse machines. The new material added in the present edition includes the semi-plug and high-pressure piston valves of the American Balance Valve Co., the Rice & Sargent-Corliss engine, including the Rites and Sargent governors and directions for setting valves and valve gears, the Nordberg valves and valve gears, the J. T. Marshall valve gear and the Sulzer steam-engine valve gear.

Small Tool Manufacturing Equipment Wanted

Advices just received from F. R. Ratcliffe, manager, small arms factory, Department of Defense, Lithgow, Australia, indicate that his arsenal will soon be in the market for equipment for a small-tool plant for manufacturing reamers, taps, milling cutters, etc., in fairly large quantities on automatic or semiautomatic machines.

The kinds of tools it is expected to manufacture are mainly profiling cutters, small end mills, small taps, mostly under ⅝ in. in diameter, with a few occasionally up to 1 in. in diameter; standard, plain, side and straddle milling cutters, rifle barrels, drills, etc.

The new equipment is desired to replace the ordinary tool-room equipment now being used at the small-arms factory.

Interested manufacturers are requested to furnish Mr. Ratcliffe promptly with catalogs, circulars and other descriptive literature.

OBITUARY

James B. Doan, Sr., father of J. B. Doan, president of the American Tool Works Co., Cincinnati, Ohio, died on June 24, aged 79 years.

Robert F. Hoxie, associate professor of political economy, University of Chicago, whose recent studies of scientific management attracted considerable attention, died on June 22.

Henry B. Brown, for many years president of the H. B. Brown Nut, Bolt and Screw Machine Co., East Hampton, predecessors of Costello Bros., died on June 15, aged 82 years.

Sir H. Frederick Donaldson, for many years mechanical head of Woolwich Arsenal and since the organization of the British Ministry of Munitions its chief technical adviser, was lost with Lord Kitchener in the sinking of the "Hampshire" on June 5.

Leslie S. Robertson, well known throughout the mechanical world through ' is long service as secretary of the British Engineering Standards Committee, and for the past year assistant to the director of production of the Ministry of Munitions was lost in the sinking of the "Hampshire" on June 5.

PERSONALS

J. A. Cutshaw has joined the selling staff of the Moller & Schumann Co. and will look after its interests in the Chicago territory.

S. H. Humphrey has resigned as vice-president in charge of manufacture of the Chalmers Motor Co., to accept a similar responsibility with the Briscoe Motor Corporation, Jackson, Mich.

H. E. Streeter has been succeeded by G. E. Smith as works manager of the Precision Tool and Machine Co., Montreal, Canada. Mr. Smith was formerly superintendent of the Singer Sewing Machine Co., St. John, Quebec.

Walter N. Polakov, recently superintendent of power of the New York, New Haven & Hartford R.R. and consulting engineer to the Board of Estimate and Apportionment of the City of New York, is now directing the foreign-trade engineering work of David Vershbinsky, Inc., New York City.

BUSINESS ITEMS

Brown & Sharpe Manufacturing Co., Providence, R. I., announces the annual suspension of the shop work from July 28 to Aug. 8. During this period the office will remain open as usual.

The Luster-Jordan Co., Inc., recently acquired the plant and business of the Jordan Machine Co., Norristown, Penn. In addition to the manufacture of the Jordan lock-corner wood box machinery, contract work will be carried on.

TRADE CATALOGS

Providence Sanitary Fountain. Harwood B. Day, 29 Weybosset St., Providence, R. I. Circular. Illustrated.

Steel Strips Hardened, Tempered and Polished. Edgar T. Ward's Sons, 44-54 Farnsworth St., Boston, Mass. Booklet. Pp. 16, 4x9 in.

Electric Hoists. Sprague Electric Works, 527 W. 34th St., New York. Bulletin No. 48,906. Pp. 32, 8x10½ in. This illustrates and describes Type S-1, one-half-ton and one-ton hoists.

FORTHCOMING MEETINGS

American Foundrymen's Association and American Institute of Metals. Annual meeting, September 11-16, Cleveland, Ohio, A. O. Backert, secretary, American Foundrymen's Association, Cleveland, Ohio.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	June 29, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$14.00	$15.00	$10.00
No. 2 X Northern Foundry, New York	19.75	20.75	14.25
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.65
Basic, Pittsburgh	18.95	18.95	13.60
No. 2 X, Philadelphia	18.25	20.50	14.25
No. 2, Valley	18.25	18.50	12.50
No. 2, Southern Cincinnati	16.90	17.90	12.65
Basic, Eastern Pennsylvania	19.50	20.50	13.75
Gray forge, Pittsburgh	18.70	18.70	13.35

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger and plates ¼ in. and heavier from jobbers' warehouse at the places named:

	New York				
	June 29, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.25	3.50	1.85	3.25	3.10
Steel T's, base	3.30	3.55	1.90	3.25	3.10
Machinery steel (bessemer)	3.25	3.55	1.80	3.25	3.10
Plates	4.00	4.10	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	June 29, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.65	2.60	3.20	3.20
No. 26 black	3.55	3.55	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.50	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.45	2.40	3.00	3.00
No. 16 blue annealed	4.45	4.70	2.35	3.70	3.60
No. 14 blue annealed	4.35	4.60	2.25	3.60	3.50
No. 12 blue annealed	4.30	4.50	2.20	3.55	3.45
No. 10 blue annealed	4.25	4.55	...	3.50	3.40
No. 28 galvanized	5.40	5.65	6.00	5.50	5.50
No. 26 galvanized	5.10	5.35	5.70	5.20	5.20
No. 24 galvanized	4.95	5.20	5.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black		Galvanized	
	June 29, 1916	One Yr. Ago	June 29, 1916	One Yr. Ago
⅜ to 2 in. steel butt welded	70%	79%	50½%	57½%
2½ to 6 in. steel lap welded	68%	78%	48½%	56½%
Diameter, In.				
¾	3.45	2.42	5.69	4.89
1	5.10	3.57	8.42	7.23
1¼	6.90	4.83	11.39	9.78
1½	8.25	5.78	13.61	11.69
2	11.10	7.77	18.32	15.73
2½	18.72	12.87	30.13	25.45
3	24 48	16.83	39.40	33.28
4	34.88	23.98	56.14	47.42
5	47.36	32.56	76.22	64.38
6	61.44	42.24	98.88	83.52

From New York stock the following discounts hold:

	New York		Cleveland	
	Black	Galvanized	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%	64%	44%
¾ to 3 in. steel butt welded	64%	42%	66%	46%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	June 29, 1916	Three Months Ago
Pittsburgh, mill	2.60	2.45
Warehouse, New York	3.25	3.10
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York					
Today	One Year Ago				
$6.00	$3.75@4.00	Cleveland	$6.30	Chicago	$5.25

In coils an advance of 50c. is usually charged.

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	June 29, 1916	Three Months Ago
New York	List price plus 20%	10% above list
Cleveland	List price plus 20%	20% above list
Chicago	List price plus 10%	List price

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets ..... $2.40 Bars $3.25

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	June 29, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	28.00	30.00	20.25
Tin	39.00	48.00	39.25
Lead	7.00	7.50	5.75
Spelter	11.75	15.00	22.00
ST. LOUIS			
Lead	6.85	7.37½	....
Spelter	11.87½	14.75	....

At the places named, the following prices in cents per pound prevail:

	New York				
	June 29, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	37.50	25.00	37.50	37.50
Copper wire (carload lots)	37.50	37.50	21.00	33.00	38.00
Brass rods, base	44.50	44.50	29.00	42.00	38.00
Brass pipe, base	46.50	46.50	33.00	45.00	46.00
Brass sheets	44.50	44.50	29.00	42.00	38.00
Solder ½ and ½ (case lots)	25.37½	30.00	28.50	28.75	25.75

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland	
	June 29, 1916	One Year Ago	June 29, 1916	Three Months Ago
Copper, heavy and crucible	21.00	17.00	20.00	25.00
Copper, heavy and wire	20.00	....	19.50	24.00
Copper, light and bottoms	17.00	14.00	17.00	21.00
Lead, heavy	5.00	4.50	5.75	7.50
Lead, tea	4.50	4.00	4.25	6.00
Brass, heavy	11.75	8.50	12.00	19.50
Brass, light	9.25	10.00	10.00	13.00
No. 1 yellow rod brass turnings	12.75	....	12.00	15.00
Zinc	8.00	15.00	8.00	16.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. and Over	6,000 Lb. and Over	2,000 Lb. and Over	500 Lb. and Over	Less Than 500 Lb. and Over
	of a Size	of a Size	of a Size	of a Size	of a Size
Rounds—Squares					
⅜ to ½	35.50	36.00	36.50	37.00	38.00
⅝ to ⅞	35.25	35.75	36.25	36.75	37.75
⅛ to 1⅞	35.00	35.50	36.00	36.50	37.50
1⅛ to 2⅞	35.75	36.25	36.75	37.25	38.25
Rounds					
3 to 3⅞	36.50	37.00	37.50	38.00	39.00
Squares					
3	36.50	37.00	37.50	38.00	39.00
Rounds					
3⅛ to 3⅞	36.25	36.75	37.25	37.75	38.75
Squares					
3⅛ to 3⅞	36.25	36.75	37.25	37.75	38.75
Rounds—Squares					
4 to 4⅞	37.00	37.50	38.00	38.50	39.50
5 to 6⅞	38.00	38.50	39.00	39.50	40.50
7	38.50	39.00	39.50	40.00	41.00
Flats	36.50	37.00	37.50	38.00	39.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick. Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 18.00

	In Casks		Broken Lots	
	June 29, 1916	Three Months Ago	June 29, 1916	Three Months Ago
New York	21.00	26.00	22.00	26.50
Cleveland	22.75	26.25	23.25	26.50
Chicago	21.00	28.50	21.50	29.00

Copper Bars from warehouse sell as follows in cents per pound:

	June 29, 1916	Three Months Ago
New York	43.00	40.00
Cleveland	40.25	39.00
Chicago	40.25	38.00

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	60.00	47.50	60.00
Commercial	30.00	18.00	25.00

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	June 29, 1916	Three Months Ago
New York	19.50	45.00
Cleveland	20.00	50.00
Chicago	22.00	44.75

Operations on the Sterling Marine Engine

By E. A. Suverkrop

SYNOPSIS—It is not the intention of this article to cover the whole process of manufacture of even one size of engine. An attempt is, however, made to show a few of the operations which impressed the author as being of special interest.

The Sterling Engine Co., Buffalo, N. Y., manufactures four-cycle marine engines exclusively. They are adapted to every type of motor boat from cargo carriers to high-speed yachts and tenders, and are built in sizes from 10 to 300 hp. The working speeds of the engines also vary within wide limits, say from 400 to 1,700 r.p.m. The heavy-duty motors will run without skipping at speeds as low as 200 r.p.m.

The bases of the engines are made of cast iron, manganese bronze or aluminum, governed by service and price, cast iron being heavy and low in price, aluminum light, but with no remarkable strength, and manganese bronze extremely strong even in a thin, light casting. Both these latter metals have of course the further advantage of not rusting when exposed to fresh or salt water.

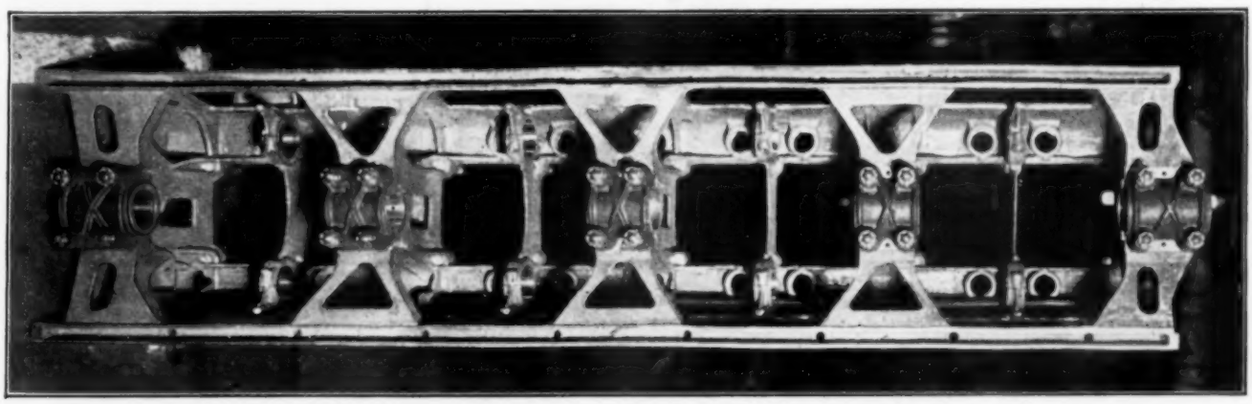


FIG. 1. MANGANESE-BRONZE CRANK CASE FOR MARINE ENGINE

One of these manganese-bronze bases is shown in Fig. 1. With the exception of the main-bearing caps it is a single casting 72¼ in. long, 16¼ in. wide and 10¾ in. deep over all. The pattern is a single block, the interior being entirely formed by cores. The walls vary from ¼ in. up. Altogether it is as fine an example of careful pattern and foundry work as I had ever seen. The only concern that has so far successfully tackled the job of molding it is the Light Foundry and Machine Co., Pottstown, Penn. The total weight of the casting is 340 lb. A larger base of similar design, but 91 in. long, 21½ in. wide and 14 in. deep, weighs 900 lb. in manganese bronze.

One thing which struck me very forcibly was the excessive care in the cleaning department. Every particle of sand is removed from the castings. This is obviously necessary, as it does not require much sand in the crank case of an engine making 1,700 r.p.m. to cause a lot of damage. The same care is also taken in cleaning the crankshafts. These are received at the factory with the main-bearing journals and crankpins ground to size. In the cleaning department the crank webs are ground all over to remove every particle of scale.

In Fig. 2 is shown an oil-hole drilling machine built in the works. The table, or bed, is of cast iron planed and provided with a longitudinal slot in which the two V-blocks slide, their centers being in line with the drill spindles. Two vertical members support the rail, on which are two carriages carrying the slides for the electric drills. The slides are arranged so that they will swivel in either direction. At the left-hand end of the table is a similar head for drilling the central oil hole *A*, Fig. 3. The heads on the rail are used for the diagonal holes *B* in the crank webs.

By referring to Fig. 3 it will be noticed that the tolerance of the bearings is +0 and —0.001 in. It is almost impossible to bore bearings commercially to limits like this, so they are broached. The leading end of the broach is toothed, but the finishing end is provided with several polished bulbs that not only bring the hole to exact size, but compress the babbitt metal and burnish the bearing surface.

When all the machine work on the crankshafts is completed, they are tested for running balance in the machine shown in Fig. 4.

In Fig. 5 is shown a flywheel that had just been completed on the Bullard vertical-turret lathe. The limits on this are very close. The shoulder at the top forms a seat for a ring spur gear that is forced and screwed on. The spur gear in place can be seen in Fig. 6. It forms part of the electrical starting mechanism. The time on this flywheel, which is about 20 in. in diameter and turned all over, is 3 hr. To a man familiar with the machine on which the work is done, this would not appear to be high production. It must, however, be borne in mind that the work is day's work and the limits very close, the "fit" for the gear wheel being to snap gage without any tolerance, which means in this case about 0.001 in.

After the gear is pressed and screwed on, the flywheel is tested for static balance in the Fay & Scott balancing machine, Fig. 6. It is brought to static balance with the drill that forms a part of this machine. The flywheels are finally tested for running balance in the machine illustrated in Fig. 4.

In Fig. 7 is shown another use for the Fay & Scott balancing machine. Here the complete reverse gear is being first tested for static balance on the horizontal ways. While the machine is portable, it is obvious that to obtain exact results even in static balances the ways must be leveled up each time the machine is moved.

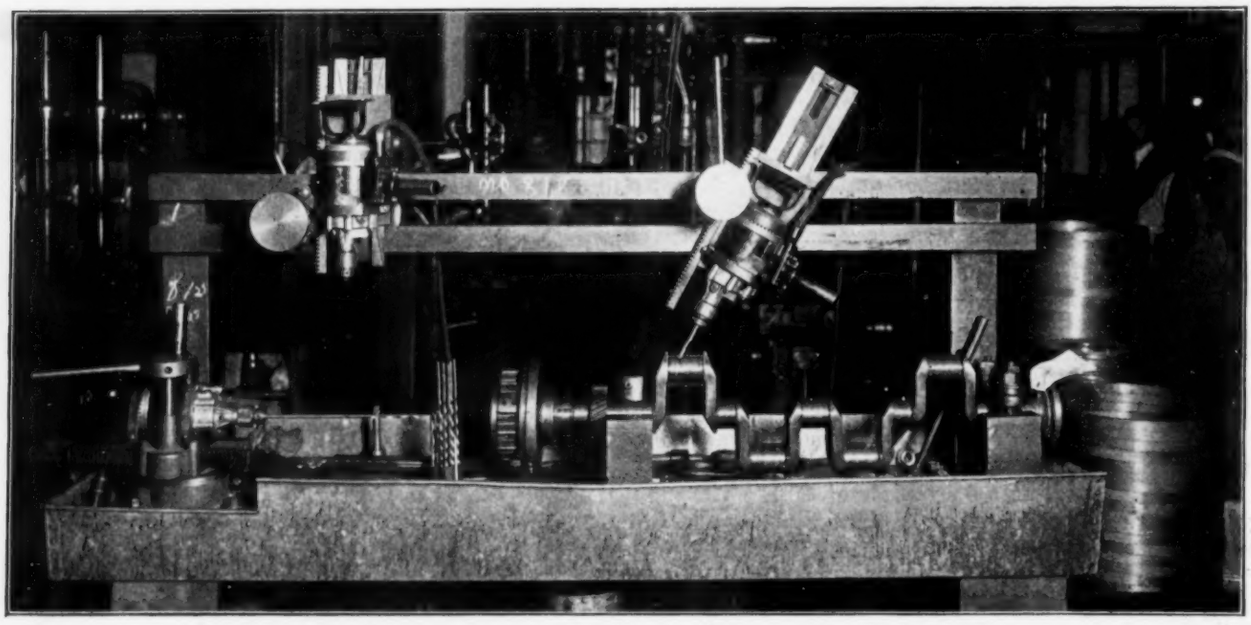


FIG. 2. OIL-HOLE DRILLING MACHINE FOR MARINE-ENGINE CRANKS

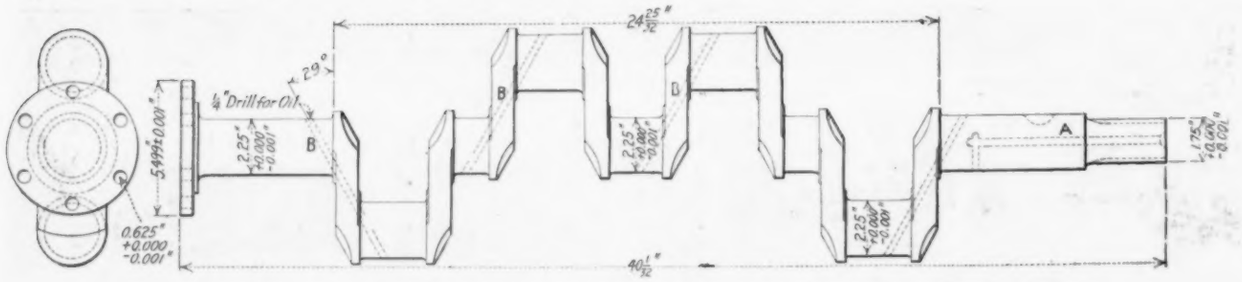


FIG. 3. DETAIL OF ONE SIZE OF CRANKSHAFT USED IN THE STERLING MARINE ENGINE

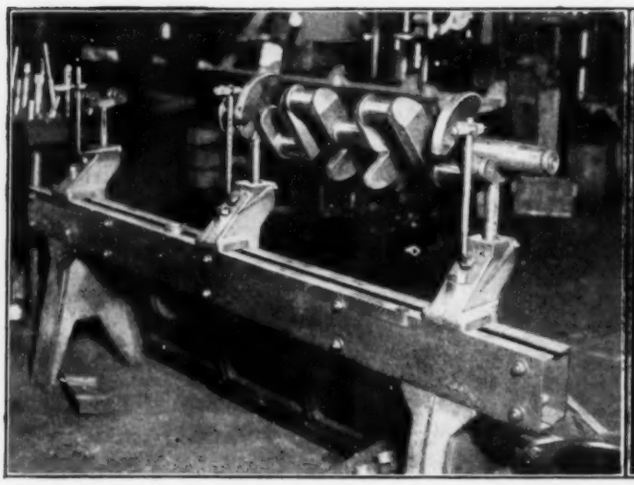


FIG. 4. RUNNING-BALANCE TESTING MACHINE AND COUNTERBALANCED CRANKSHAFT

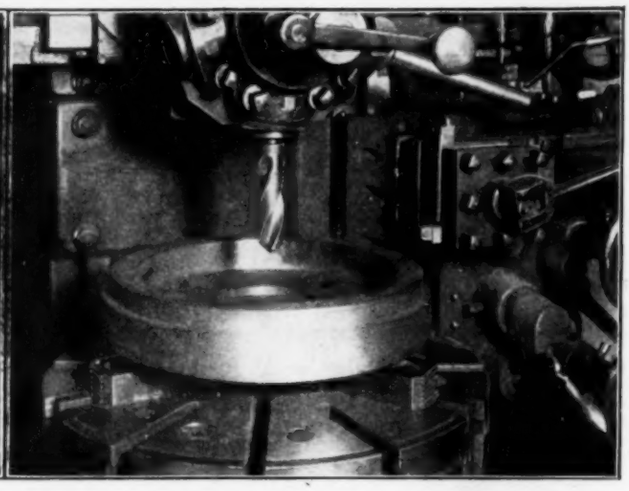


FIG. 5. TURNING FLYWHEEL ON BULLARD VERTICAL-TURRET LATHE

The reverse-gear clutch shown is of the well-known disk type, with alternate steel and bronze disks alternately engaging with the central-shaft member and the case.

The turning of the bronze disks, shown in Fig. 8, is a nice job, as these are required to be within 0.003 in. of uniform thickness. The original castings are about $\frac{5}{16}$ in. thick. In approximately four cuts, taken on alternate sides to prevent buckling, the disks are reduced to $\frac{1}{8}$ in. in thickness.

It will be observed that a special eight-jawed chuck is used to obviate distortion as much as possible. The disks vary in diameter with the size of the clutch, but 12-in. disks require about 15 min. to finish-turn.

In Fig. 9 is shown the drilling of the holding-down bolt holes in a cast-iron base. Mounted on the table of the radial drilling machine are two tracks made of planed channel steel. Bosses that cannot be reached by swinging the arm are brought into range by sliding the bed on the rails. The holes for the holding-down

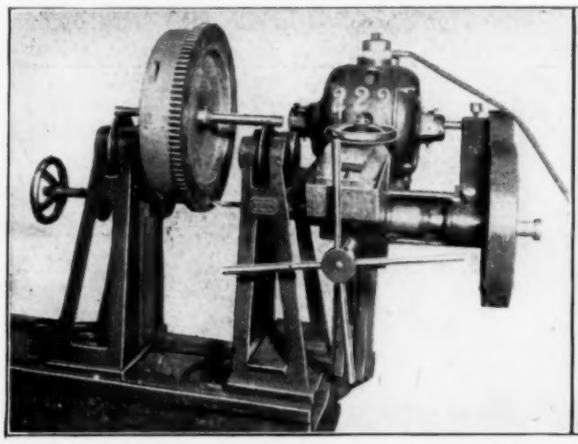


FIG. 6. DRILLING FLYWHEEL FOR STATIC BALANCE

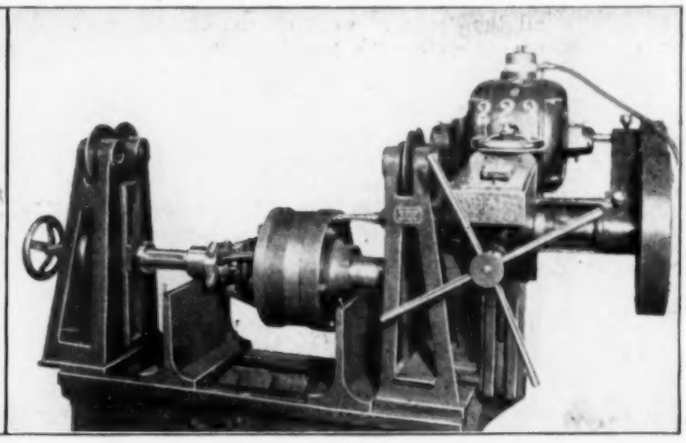


FIG. 7. BALANCING A REVERSING GEAR

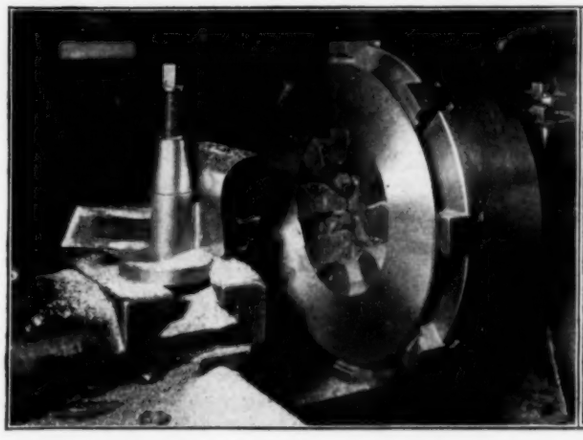


FIG. 8. TURNING BRONZE CLUTCH DISKS

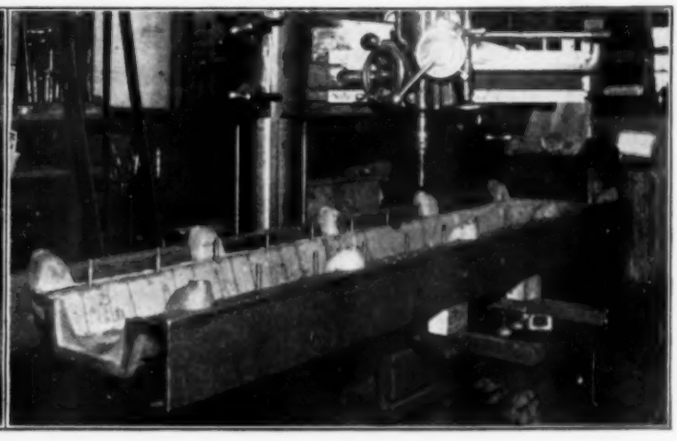


FIG. 9. DRILLING HOLDING-DOWN BOLT HOLES

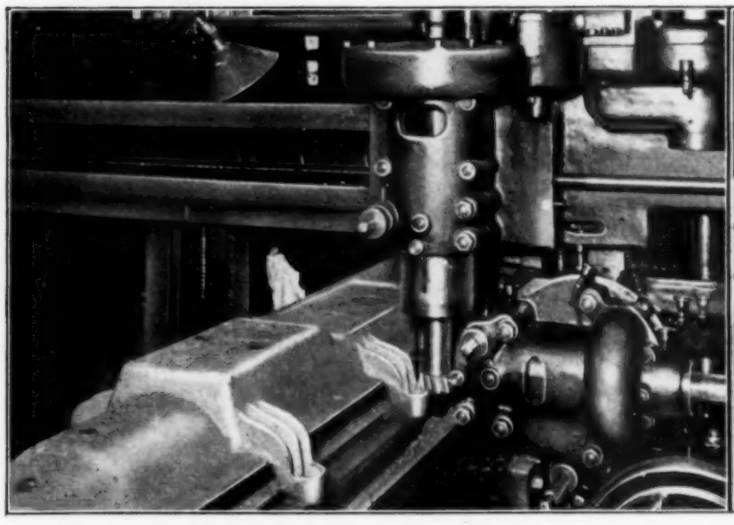


FIG. 10. INGERSOLL MILLER FOR BASES AND CRANK CASES USED FOR "PLANER" WORK

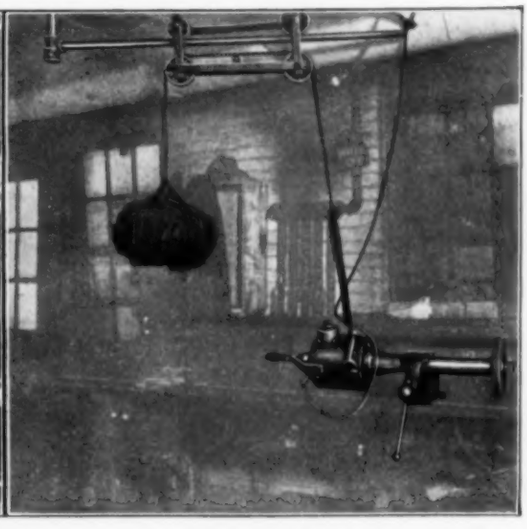


FIG. 11. PORTABLE GRINDER IN THE CLEANING DEPARTMENT

bolts do not require to be spaced accurately, so no jig is used. The holes for the studs that secure the crank case to the base must be accurate. They are drilled with the aid of a light steel jig, or perhaps more correctly a templet with drill bushings.

Practically all the "planer" work on the crank cases and bases is now done on the heavy Ingersoll miller, Fig. 10. With the adoption of the miller for this work the production has been more than doubled.

The electric portable grinder illustrated in Fig. 11 is used in the cleaning room. It hangs, as shown, from a swinging crane. The counterweight is padded with rags to soften the blow, should someone inadvertently bump into it. When the work is small and easy to manipulate, the grinder is clamped by the sleeve in the vise, as shown, and the operator takes the work to the grinder.

In Fig. 12 is shown a Baker double-spindle cylinder-boring machine. The surface of the cylinders, which bolts to the crank case, is milled in the first operation on a heavy Brown & Sharpe vertical miller. In the boring operation this surface is bolted to the boring-jig plate *A*, which slides against stops in the jig body *B* and is clamped in place, as shown. Two plates *A* are employed, which permits the boring operation to be practically continuous.

The cylinders shown in Fig. 12 are 5½ in. in diameter by 12 1/16 in. deep when finished; 5/16 in. of metal is removed in two roughing cuts and one finishing cut. It takes about 14 min. for the cut. For the four-cylinder engines, in which the cylinders are cast *en bloc*, a four-spindle Baker cylinder-boring machine is used.

The pistons are at present turned on a Jones & Lamson flat-turret lathe. For the first operation the piston, shown at *A* in Fig. 13, is chucked in a four-jaw chuck with the lower or open end outward. It is trued by the inside. The open end is faced and bored to a depth of about 3/8 in., a flange projecting inwardly being provided on the casting for this purpose. This operation takes about 5 min.

The wristpin hole is then bored on the Baker drilling machine, Fig. 13. The bored and faced end of the piston is centered on a seat at *B*, against which it is forced by the handwheel and screw *C*. The sliding plug *D* is provided with a wedgelike fork on its inner extremity. This fork squares up the bosses on the inside of the piston, bringing the piston in correct position so that the wristpin hole will pass through the center.

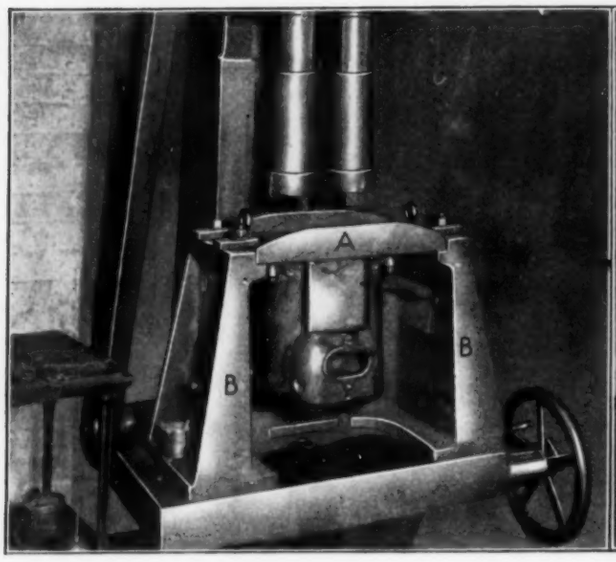


FIG. 12. BAKER CYLINDER-BORING MACHINE

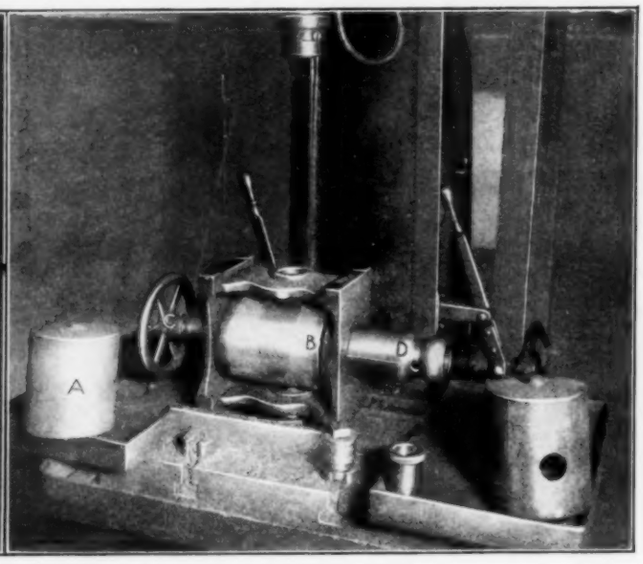


FIG. 13. DRILLING WRISTPIN HOLES IN PISTONS

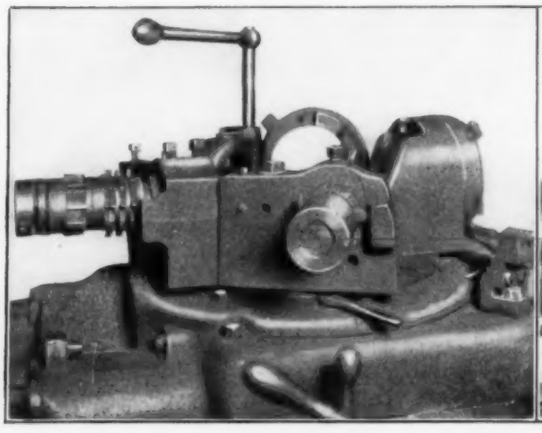


FIG. 14. ROUGH AND FINISH GROOVING TOOLS

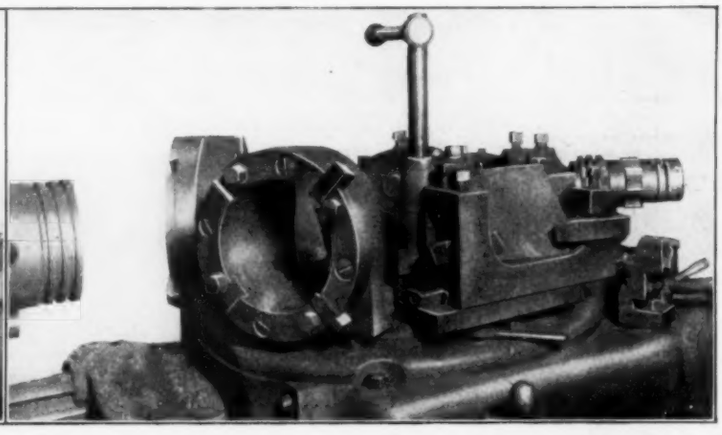


FIG. 15. TURNING AND FACING TOOLS FOR PISTONS

For burning, the pistons are chucked against a seat similar to that used in the drill jig in Fig. 13, with this exception: An eye-bolt passes through the hollow spindle of the Jones & Lamson lathe, and a pin passed through the wristpin hole enters this eye-bolt. At the rear end the eye-bolt is provided with a thread and handwheel to draw the piston to the seat.

The exterior is turned 0.010 in. oversize for grinding. The turning operation covers two roughing cuts on the body, roughing the three ring grooves and the three oil grooves, finishing the three ring grooves, facing the end and centering the end for the grinding operation—all of which takes about 20 min. on a 6-in. piston.

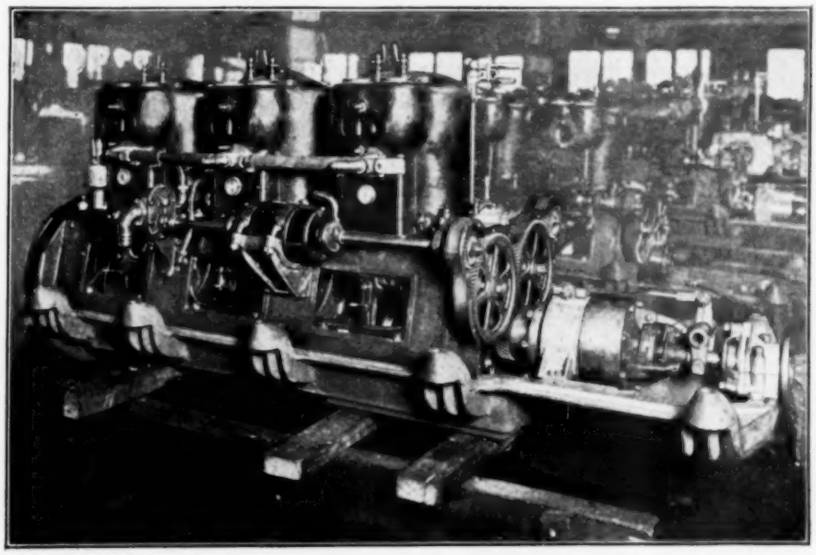


FIG. 16. PARTLY ASSEMBLED SIX-CYLINDER MARINE ENGINE

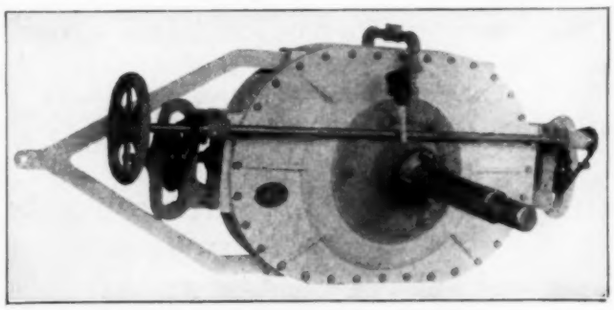


FIG. 17. STERLING WATER DYNAMOMETER

In Fig. 14 are shown the grooving tools. These are similar to milling cutters with coarse-pitch teeth. On the inside they are keyseated to prevent their turning on the bar. Collars space them the correct distance apart. It will be noticed that the oil grooving tools—that is, the broad one in the center and the two to the left—are of smaller diameter than the ring grooving tools.

In Fig. 15 the turning and facing tools are illustrated. In Fig. 16 is shown a partly assembled six-cylinder 110- to 140-hp. Sterling engine. This illustration gives some idea of the compact manner in which the mechanism is housed.

After assembling, all Sterling engines are given a running test from one to two days or longer, depending on circumstances. The testing department is in a separate building, and each testing base is provided with a water-brake dynamometer built by the company. An exterior view of this dynamometer is shown in Fig. 17.

Within the casing and secured to the central shaft is a rotor that is a circular casting with radial pockets on each side. On the periphery also there are pockets. The brake is supplied with water from any convenient source. The water is thrown from the side and face pockets of the rotor into corresponding reversed pockets in the casing and side plates. The force with which the water is thrown is in proportion to the speed of the rotor, and its impact tends to rotate the casing. Flat plates between the rotor and the end plates are adjustable to and from the center of the shaft and serve to cut off the amount of water thrown from the rotor, thus regulating the resistance, which can further be regulated by varying the amount of water admitted. The torque arm, at the left, is 31.152 in. long. It is attached to a weighing scale of any convenient type. The length of the torque arm simplifies the calculation of the power delivered by the engine, the formula being

$$\frac{Pounds\ pull \times r.p.m.}{2{,}000} = hp.$$

When the test has been satisfactorily concluded, the engine is disassembled, and examined to see the condition after test. The various parts are then cleaned, the engine reassembled, painted, bolted to skids and, if for foreign shipment, boxed.

Patterns for a Gas-Engine Cylinder and Head

By H. E. McCray

There are as many ways of making gas-engine cylinder and cylinder-head patterns and core boxes as there are engine builders in the country, and it is no extraordinary occurrence to see several kinds of patterns in one plant. The idea of this contribution is not to outline a standard method, for conditions differ widely, but to illustrate what we have found after considerable experience to be the best and cheapest way.

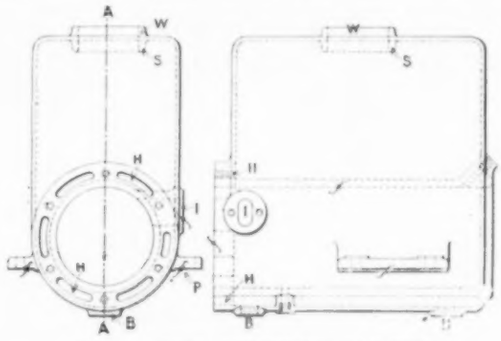


FIG. 1. THE CYLINDER CASTING

In Fig. 1 is shown an example of a common type of cylinder casting. It is cast separate from the engine bed. With a few variations in shape and ports, we find

it typical of "two-piece" engine construction. The pattern is parted along the center line *AA* and has six core prints. Two of these support the cylinder-barrel core, which is a straight round core. The igniter port core *I* is located for convenience in setting, in the drag and is held down by the cylinder-barrel core, as it projects through the water-jacket core. It is also a straight core, but has one end rounded to conform to the

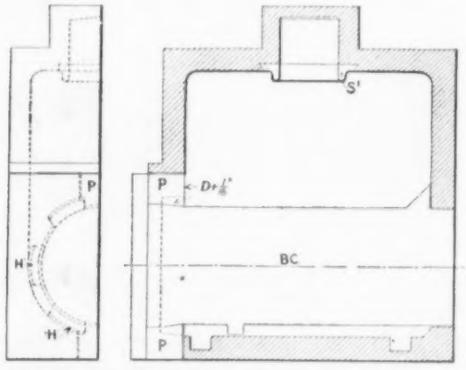


FIG. 2. THE WATER-JACKET CORE BOX

barrel core. The water-jacket core is made in halves and is supported at three points—the filler hole at *W* and the ports *BB*, later pipe tapped and plugged.

The cylinder head is held in place by six bolts, and between each pair of bolt lugs is a water core *H* to allow water to circulate around the cylinder head. The water-jacket core box is seen in Fig. 2, which shows how these cores are formed without loose pieces. The semicircular section *BC* forms the outside of the cylinder barrel and rests in each end of the box. It is of course removable to allow tucking and to draw the box off the core when completed. Before the core is rapped out of the box, however, a half-round cast-iron drier is inserted in place of *BC*, preventing any sag that might otherwise take place in baking.

The water-port cores *H* are formed by openings cut in the solid box and are arranged in such a way as to draw out with the main core. The pieces *P*, which would prevent drawing if solid with the box, are fastened to the plate at the end of *BC* and lift out with it. They

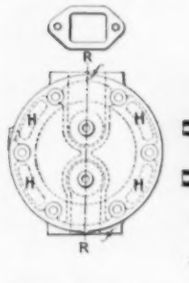


FIG. 3. THE CYLINDER-HEAD CASTING

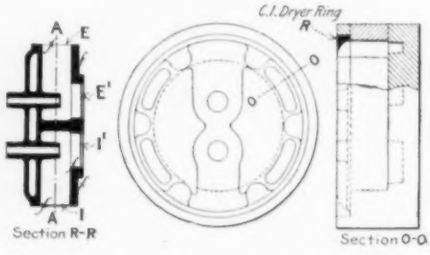


FIG. 4. CYLINDER-HEAD CORE BOX

also act as squaring strips, to maintain the bosses solid with *BC* at the proper angles. The water cores *H* do not have prints on the pattern, nor do they touch the mold, as they project only $\frac{1}{16}$ in. beyond the finished dimension of the cylinder face. Even though filled over on the rough casting, the roughing cut over the face opens them up. With a four-bolt head, the bolt lugs located at 45 deg. from a vertical center line—the customary spacing—the core box is even simpler, as the pieces *P* do not interfere with drawing the core. The splash guard *S* is dovetailed into the box and draws out with the core, this being the only loose piece in the box. The illustration shows the cope half of the box; the ignited-core boss *I*, Fig. 1, is fastened in the other half.

The drag, or igniter-pad, half of the jacket core is set in the mold first, then the igniter core through its opening, followed by the barrel core and the cope half of the jacket core. No chaplets are required.

The cylinder head is illustrated in Fig. 3. It will be noticed that the water circulates over the top of both inlet and exhaust ports and completely around the valve bosses. This construction was adopted for two reasons—the better cooling afforded the valve stems and the preservation of the paint over the exhaust port. The water-port cores are also marked *H*. They register with the cylinder water ports.

The cylinder-head pattern is parted at *AA*, the center line of the valve ports and pads. The cylinder step, or finished side, which is the drag half of the other half carrying the valve bosses, lifts with the cope and is drawn out of it. This arrangement is for convenience in core setting and closing the mold. The inlet- and exhaust-port cores are supported by two prints each—at *I* and *I'* and *E* and *E'* respectively. These are made in half boxes and pasted together before setting.

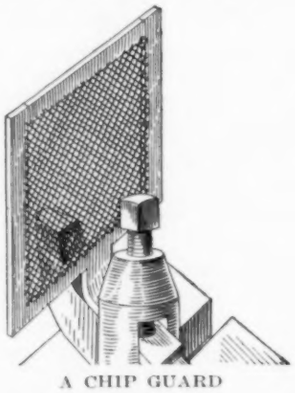
The water-jacket core is located by the print *H*. The core box, Fig. 4, is a solid box with open top, the blocks forming the ports, bolt lugs being glued in place. The radius over the top is formed by the cast-iron drier ring *R* set in place after the sand is well tucked. The section of the drier ring is approximately that of a fillet, as shown in Fig. 4. The core is struck off and slicked, then rapped out on the drier ring, which prevents any warping and permits easy handling of an otherwise delicate core.

The port cores are set into the drag first and the water-jacket core over them, with thin sheet-metal chaplets between. A height gage is provided so that the cores are not pressed too far into the mold. Four chaplets are then placed on the jacket core and the mold closed.

Chip Guard for Machine Tools

By William Torray

The accompanying illustration represents a guard for chips. It has been used successfully on lathes. The



A CHIP GUARD

device, which is clamped with the tool in the holder, hardly needs any explanation.

Caring for Small-Shop Bearings

By John H. Van Deventer

SYNOPSIS—This article takes up some of the practical points in connection with the construction and operation of shaft bearings and tells how to make simple tests of the quality of the lubricant.

"How are you getting on with that perpetual-motion machine, Uncle Billy?"

"There is only one thing now left to be overcome, and then the machine will go."

"And what's that, Uncle Billy?"

"Oh, just friction."

Friction is the curse of the perpetual-motion inventor, and it is indeed more or less of a nuisance in the shop anyway, except in the case of pulleys and belts, where it is quite desirable to have a fair share of it. Like all other evils, it has its uses; but like most other evils, it is easier to make use of its advantages than it is to minimize its disadvantages. And then if it weren't for friction, the oil dealers would lose their jobs and the price of gasoline would go up another notch to keep up the general average.

A good deal of the friction that is ordinarily attributed to bearings is in reality actual mechanical binding. Take a case of three, or even two, bearings on a bedplate. Unless the section of this plate is extremely rigid, any mechanic will know that it can be easily sprung out of shape to suit the lack of level or flatness level of the floor on which it is placed. It is almost impossible to line up three bearings upon a single shaft without producing more or less of this binding, which is the reason that the sale of flexible couplings is on the increase. Even the use of self-aligning bearings does not do more than make it easier for the shaft to bend under these conditions. The remedy in a case of this kind is to use a flexible coupling and self-aligning bearings, dividing the work between two shafts, as shown at *C* in Fig. 1. This arrangement costs more than the arrangement shown at *A;* but the man who is going to use this outfit will pay the difference, if its disadvantages are properly explained to him.

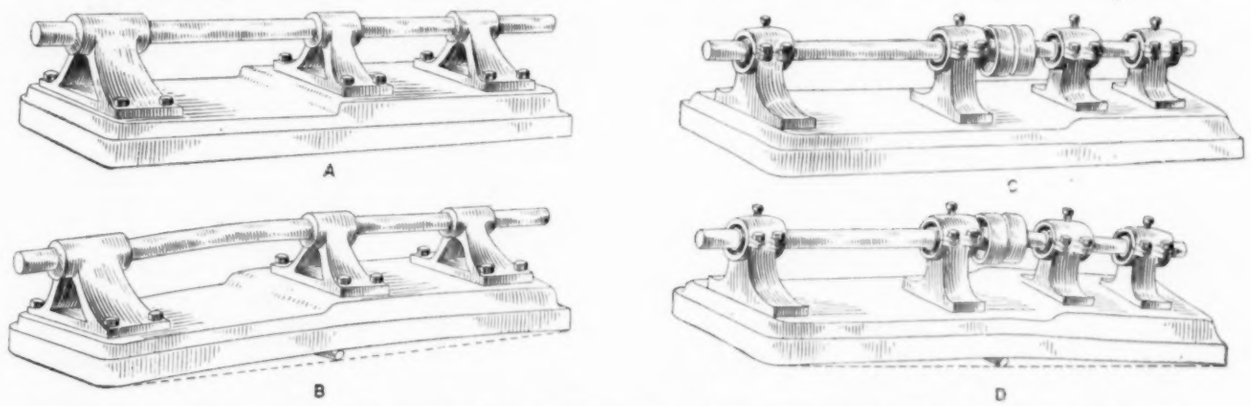


FIG. 1. SELF-ALIGNING BEARINGS AND A FLEXIBLE COUPLING MAKE BEARING FRICTION A MINIMUM

A and B—three rigid bearings on one shaft are certain to result in loss of power. C and D—four self-aligning bearings and a flexible coupling increase the first cost, but pay dividends

Friction is blamed for a lot of things of this kind that really should not be laid at its door. As a matter of fact, the reason that many shafts run at all is because they possess enough flexibility to let them turn the corners imposed upon them by bearings that are out of line.

When a bearing heats up because something of this kind is the matter with it, conditions are wrong and

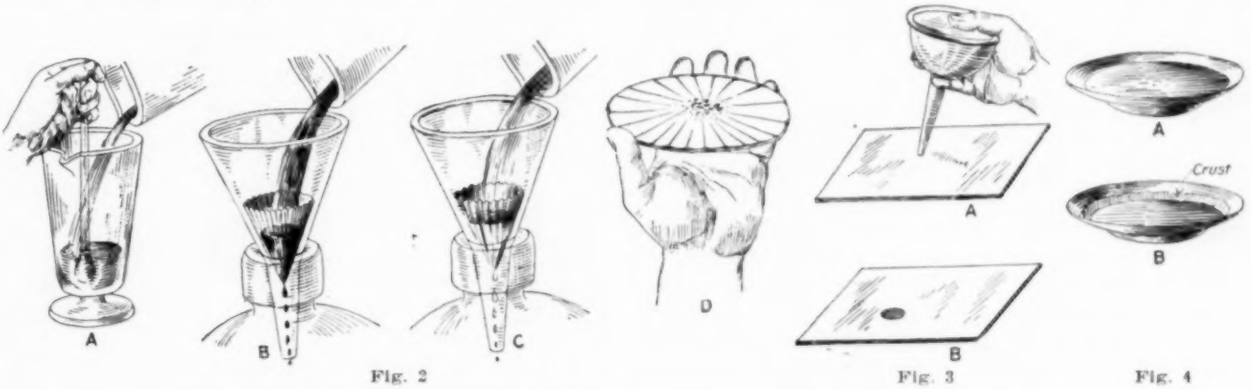


Fig. 2 Fig. 3 Fig. 4

FIGS. 2 TO 4. VARIOUS TESTS OF OILS TO DETERMINE PRESENCE OF IMPURITIES

Fig. 2—Testing oil for solid impurities. A—Thin the oil with kerosene. B—Strain through filter paper. C—Wash the oil through with pure kerosene. D—Examine the filter paper for a residue of solid particles. Fig. 3—Testing oil for the presence of acid. A—Put a drop of oil on a polished brass sheet. B—A green spot on the brass after several days denotes acid in the oil. Fig. 4—Testing oil for the presence of resins. A—Put some oil in a saucer and leave in a warm place for several days. B—If a crust forms, it shows the presence of resins

should be changed, but the mere fact that a bearing gets hot does not indicate that anything serious is the matter. A modern theory has it that the hotter a bearing becomes the more efficiently it runs and the less power it wastes in friction. If made properly, bearings can be run hot enough to fry an egg upon their surface, and yet this heat need not be the cause of alarm. However, this is true of the fast-running shafts that rotate one or more thousands of revolutions per minute. When the slower-moving small-shop bearings get hot enough for culinary purposes, it is time, ordinarily, to do something with them.

A hot bearing may be caused by lack of proper lubrication or by lack of sufficiently good workmanship, and sometimes, not infrequently, it is due to a lack of knowledge on the part of the man who designed the bearing and who made it too small for the load. In the majority of cases, however, trouble is usually traced to a lack of proper lubrication.

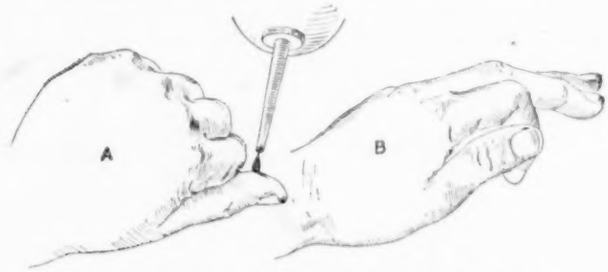


FIG. 5. A SIMPLE SHOP TEST FOR VISCOSITY

A—Place a drop of the oil on the ball of the thumb. B—If you can squeeze out the "slippery feel" by rubbing a short time, the oil lacks lubricating qualities

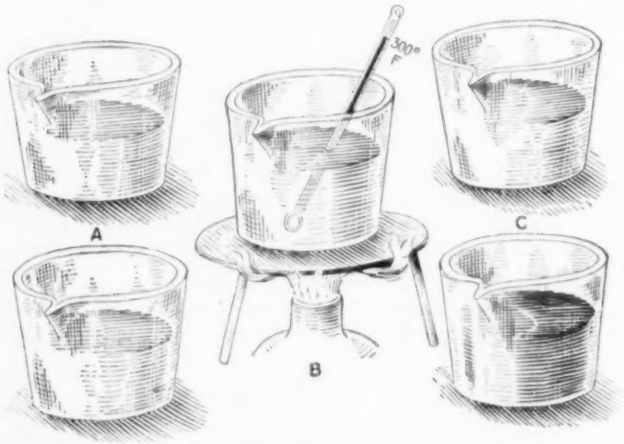


FIG. 6. TESTING OIL FOR THE PRESENCE OF SULPHUR

A—Put a quantity of oil into each of two glass vessels. B—Heat one of the samples to 300 deg. F. and maintain this temperature for 15 min. C—If the heated sample turns darker than the original, it indicates the presence of sulphur

Thus, the first and greatest rule in caring for small-shop bearings, and in fact any other, is to keep them lubricated with a lubricant of good quality, suitable for the work that they have to do.

Of course, there are people who simply will not oil a machine, out of general principles, I suppose, these people usually *not* being the ones who pay for the machines in the first place. Then there are others, and more of them, who do not neglect to oil machines on principle, but because of forgetfulness. The injury done by one of these fellows is as bad, however, and the aggregate damage is much greater. I have seen shops (and big ones, too) where a machine that was in common use by a number of men went oilless because each one would look to the next fellow to oil it.

The crudest oiling device that exists is the "oil hole" to which oil is applied with a squirt can. The use of

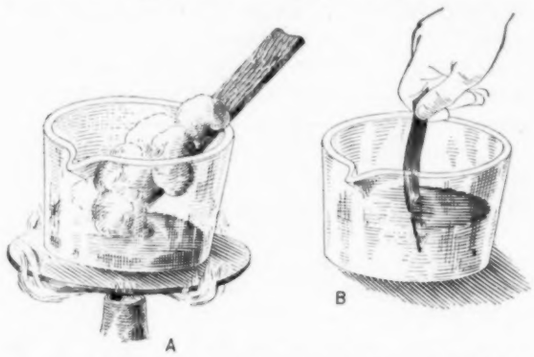


FIG. 7. TESTING THE "NEUTRALITY" OF GREASE

A—Melt a quantity of the grease. B—Test with litmus paper. If blue litmus paper turns red, it indicates acid; if red litmus paper turns blue, it indicates alkalies. A very slow change of color indicates a neutral grease

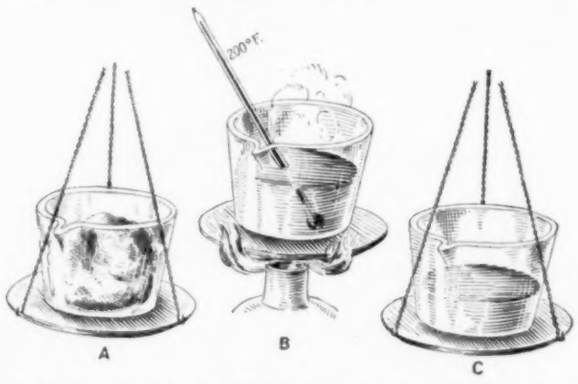


FIG. 8. TESTING GREASE FOR VOLATILE MATTER

A—Weigh a quantity of grease on a sensitive balance. B—Heat at 200 deg. F. for 2 hr. C—Weigh again. The difference in weight is an indication of the amount of volatile matter, such as benzine, naphtha, etc., in the grease

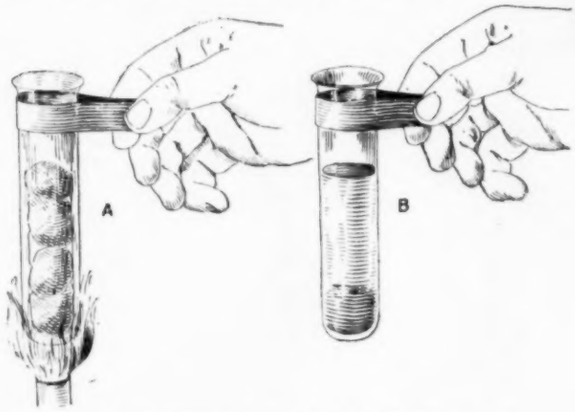


FIG. 9. TESTING A GREASE FOR "FILLING"

A—Melt some grease in a test tube. B—A cloudiness at the bottom of the tube indicates soap or other filling

the word "engine lathe" is almost a slander on the steam engine, for no matter how depraved and lost to hope be the designer of an engine he still retains a certain sense of shame that prevents him from tectotally ruining the design of his engine by providing for squirt-can lubrication. No, indeed, he puts on sight-feed oilers, even on farm engines in which the bearings are not scraped. What a pity to see excellent workmanship

wasted on hardened and ground spindles and high-grade bronze bushings such as we find in machine tools and then to think that the lubrication and like of these expensive bearings are left to the chance finding of a squirt-can hole! When you get a machine in which the important bearings have been mistreated in this way, do yourself a favor by tapping out the holes and adding

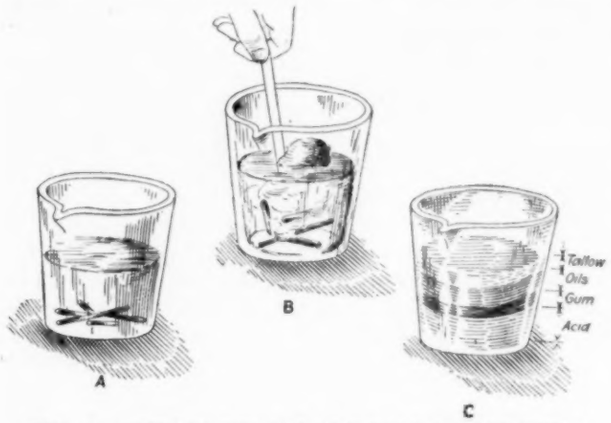


FIG. 10. TESTING GREASE FOR TALLOW AND GUMS

A—Place some pieces of copper wire in a concentrated solution of nitric acid. B—Add some grease and stir. C—After an hour the ingredients will arrange themselves as shown

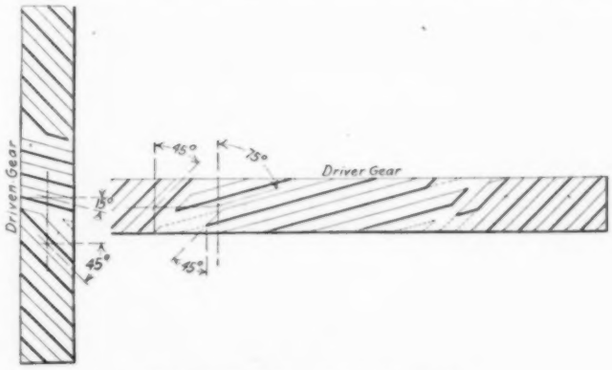
sight-feed oil cups, incidentally crediting yourself for this act by adding a couple of years to the probable life of the machine on your depreciation sheet.

An article of this length is a small place to cover the big subject of bearings, even for small shops. The man who is interested in the design and operation of bearings will find this subject fully covered in the "American Machinist Bearing Book." So I will use this space for pointing out certain simple tests for oils and greases—tests which need not be made in the laboratory, but which can be made in Mrs. Small-Shop Man's kitchen, if necessary.

Intermittent Spiral Gears

By D. Watson

The illustration shows the developed layout of double-lead intermittent spiral gears on the pitch line. These double-lead spiral gears were used on a special machine



INTERMITTENT SPIRAL GEAR

for milling work that had 15 lugs about 2 in. apart in a straight line. They were too far apart to let the cutter run idle over the spaces at the regular cutting feeds. These gears made it possible for the table to run intermittently, slowly when milling the lugs and fast across the spaces.

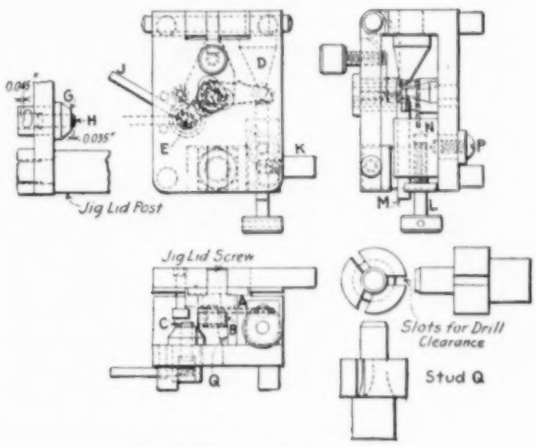
It will be noticed that the teeth on the driver gear are cut on angles of 75 and 45 deg. with its axis, and the teeth on the driven gear are 15 and 45 deg. with its axis. When the 75-deg. teeth on the driver gear are in mesh with the 15-deg. teeth on the driven gear, the driven gear revolves slowly; but as soon as the 45-deg. teeth of the driver gear are in mesh with the 45-deg. teeth on the driven gear, the driven gear revolves fast.

It is understood that the driver gear revolves at a constant speed, only the driven gear changing speeds. The full lines show the gears complete; the dotted lines show the part of the teeth that must be removed with an end mill to allow freedom in turning.

Feather-Pinning Jig

By M. A. Bowyer

Fig. 1 shows what is known as a feather-pinning jig. Into the holes drilled in the pieces rivets are driven and riveted over. The work consists of three pieces—*A*, *B* and *C*. The piece *B* is made of $\frac{7}{16}$-in. cold-rolled steel, with a $\frac{3}{16}$-in. hole drilled and reamed in it and a hub $\frac{1}{4}$ in. in diameter on each end. These hubs are as long respectively as the thicknesses of the pieces *A* and *C*, which have a $\frac{1}{4}$-in. hole reamed to fit over the hubs. The important stop-



FEATHER-PINNING JIG

ping point on the piece *A* is shown in contact with the stud *D*. The locating point of the piece *C* is the hole *E*.

This jig was first made with a solid stud at *E*, but the workmen had trouble getting the work off, owing to the extremely snug fit in the hole and also on account of the thin, springy material. These unsatisfactory conditions were improved upon, as shown.

The device now consists of a cam arrangement that allows the locating stud to drop out of the hole. The small hole of the part *G* is lapped to fit the locating stud *H* snugly. The lever *J* is shown by full lines in the position it has when the work is loaded and by the dashed line when the work is unloaded.

It is not good policy to use a screw against as thin a piece as *A*, so the clamping of this part on the stud *D* is done by the screw *L* acting on the pin *M*. The stud *N* has a tenon turned on one end, driven into the jig and held by the screw *P*. The handle *K* is used to raise the lid.

Tools Used in Machining a Turret-Lathe Head

By Robert Mawson

SYNOPSIS—In this article are shown the tools for machining the head, tailstock and apron of a turret lathe. The fixtures used in boring the head and tailstock are provided with long guide bearings. Slip bushings are furnished to guide the bars during the rough- and finish-boring operations. The drilling jigs for the head are supplied with locating plugs so that the holes are machined in alignment. The apron jig locates the rough casting after the bar has been machined and is provided with a cover.

On page 1007, Vol. 44, is shown a turret lathe made for the Reed-Prentice Co. by the Blake & Knowles Steam Pump Works, East Cambridge, Mass. In this article are illustrated some of the tools for machining important parts of these lathes. The fixture used in boring the head is designed with supports at each end and in the center. The planed base of the casting is located against pins and screw poppets tightened against bosses to hold the casting against strains. Straps hold the casting securely during the boring operation. In the jigs employed in drilling, plugs fit into the bored holes to produce the desired alignment.

The tailstock boring jig has straps and setscrews to hold it in the fixture after it has been located by pins. In this tool the same design of boring bearings to obtain good alignment is observed as was shown in the head-boring fixture. The jig for the apron is provided with a cover and, after the casting has been accurately placed and clamped in the tool, is held down with swinging bolts. It will be observed that this latter is provided with substantial legs forming an integral part of it.

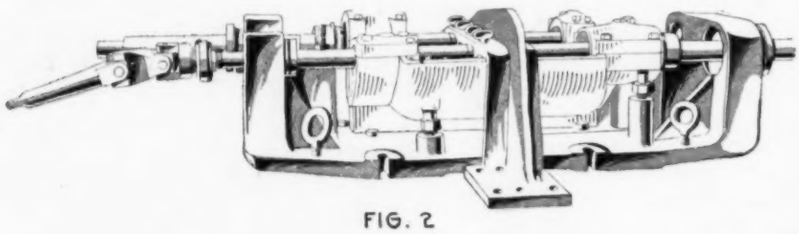


FIG. 2

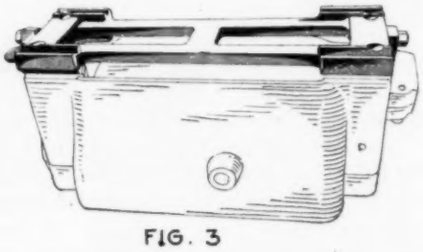


FIG. 3

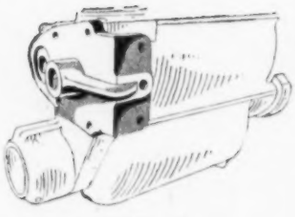


FIG. 4

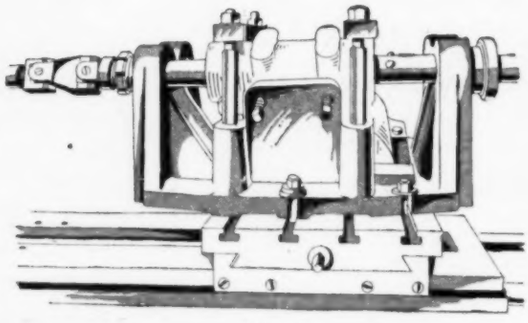


FIG. 6

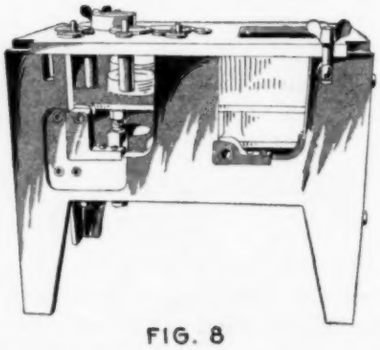


FIG. 8

JIGS AND FIXTURES USED IN MACHINING A TURRET-LATHE HEAD, WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operation—Boring the head, Fig. 1. The planed casting is located against pins and held down with straps. Screw poppets are then tightened against bosses to assist in holding the casting against the boring strains. The bars are guided at each end and through a bracket in the center.

Holes Machined—One 5-in., one 2½-in., one 4⅛-in. and one 5¾-in. bored.

FIGS. 3 AND 3-A

Operation—Drilling holes in base of head, Fig. 1. The jig is placed on the planed base of the casting and forced back against an adjustable stop with a setscrew.

Holes Machined—Four ⅞-in. drilled.

FIGS. 4 AND 4-A

Operation—Drilling holes at end of head, Fig. 1. Jig is located by a 4.122-in. plug that fits into the 4⅛-in. bored hole. On the right-angle side of the jig a plate rests against the planed base, thus locating the jig.

Holes Machined—Four $^{27}/_{64}$-in. drilled and one 1½-in. spot-drilled and reamed.

FIGS. 6 AND 6-A

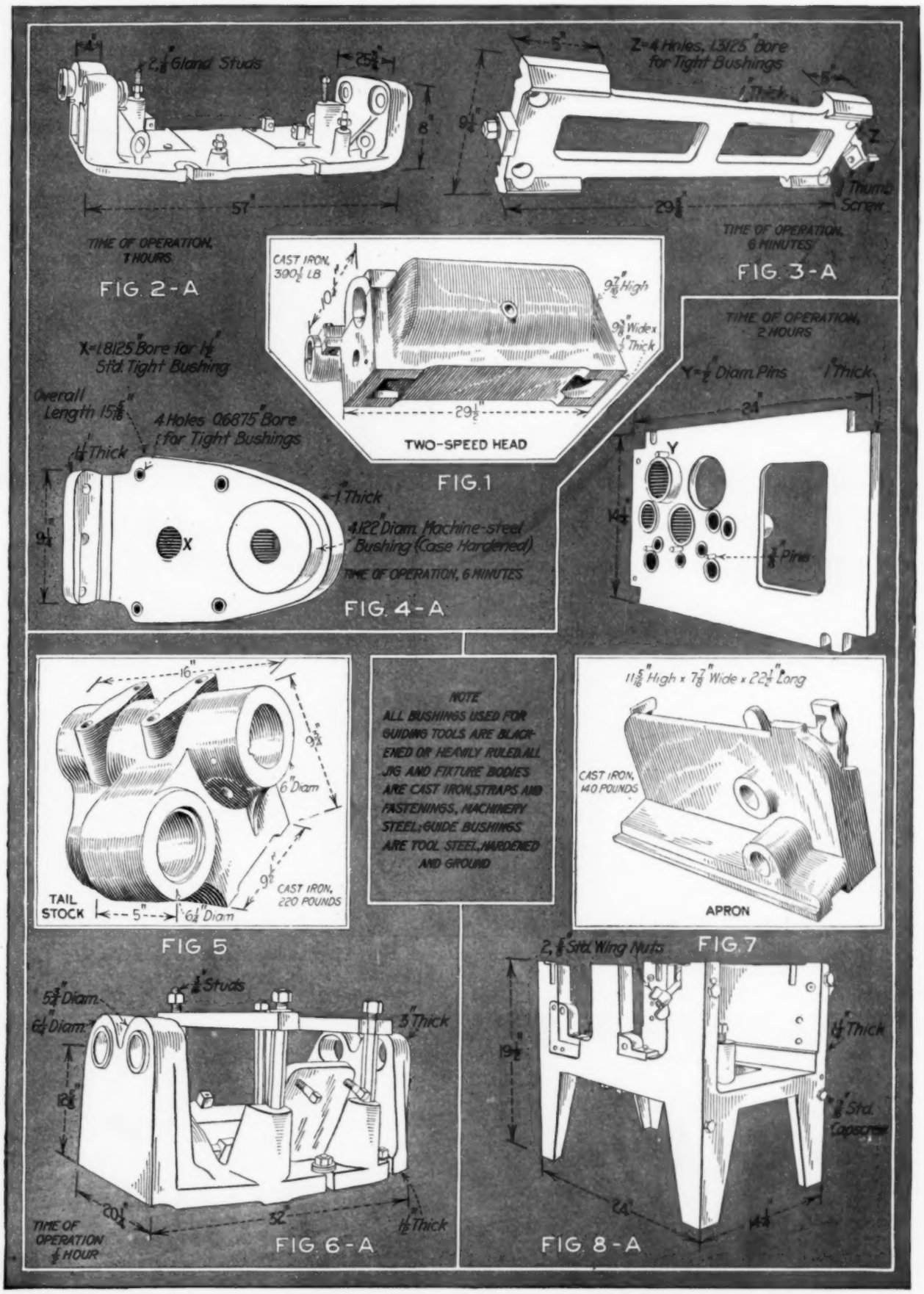
Operation—Boring tailstock, Fig. 5. The machined casting is located by stops and held down by setscrews on the sides and straps on the upper surface. The boring bars are guided at both ends by boring tool-steel hardened bushings.

Holes Machined—One 4¼-in. bored and one 3⅞-in. bored. The end of the latter hole is tapped for ¾ in. with a 4-in.-12 U.S.F. thread. The bars on this fixture are arranged with one-point cutters.

FIGS. 8 AND 8-A

Operation—Drilling and reaming apron, Fig. 7. The milled casting is placed on adjustable screws and held down by straps. The cover of the jig is placed in position, being held with nuts on bolts fitting into slots.

Holes Machined—One $^{47}/_{64}$-in. drilled, one ¾-in. spot-drilled and reamed. One 2¼-in. spot-drilled and reamed, one hole drilled for 1⅞-in.-14 U.S.F. threads, one 1½-in. spot drilled and reamed, two ½-in. drilled, four $^{7}/_{16}$-in. drilled for ⅜-in. U.S.F. threads.



DETAILS OF JIGS AND FIXTURES USED IN MACHINING A TURRET-LATHE HEAD

Interesting Hardening Plant

By A. Towler

The Gray & Davis Co., Boston, Mass., has recently designed and built an interesting hardening department in connection with its factory. In Fig. 1 is shown a plan of the department.

A noteworthy feature of the arrangement is the overhead trolley for conveying to the various furnaces and tanks the parts being hardened. The trolley is also useful for carrying the compound and bone to the hopper, from which they can be dropped down to the packing bench as required.

A view of the side of the department where the muffles, small crude-oil furnaces and lead pots are placed is shown in Fig. 2. In Fig. 3 are illustrated the cooling-oil tank, with cooling screen over it, also the motor-driven blower and air compressor. In front of the air compressor may be seen a number of tote boxes with parts ready for hardening or heat-treating. In front of the oil tank and screen may be observed the hot-potash tank; in one corner is the steam pipe for heating the liquid. This hardening department was designed after much investigation on the subject and is giving good satisfaction under regular commercial conditions.

It will be seen that provision has been made in this plant for storage of both stock and work. This is a feature worth noting as the space is large enough so that the parts either before or after hardening may be placed in stock and drawn upon as needed thus avoiding any delays.

FIG. 4. VIEW OF FURNACES

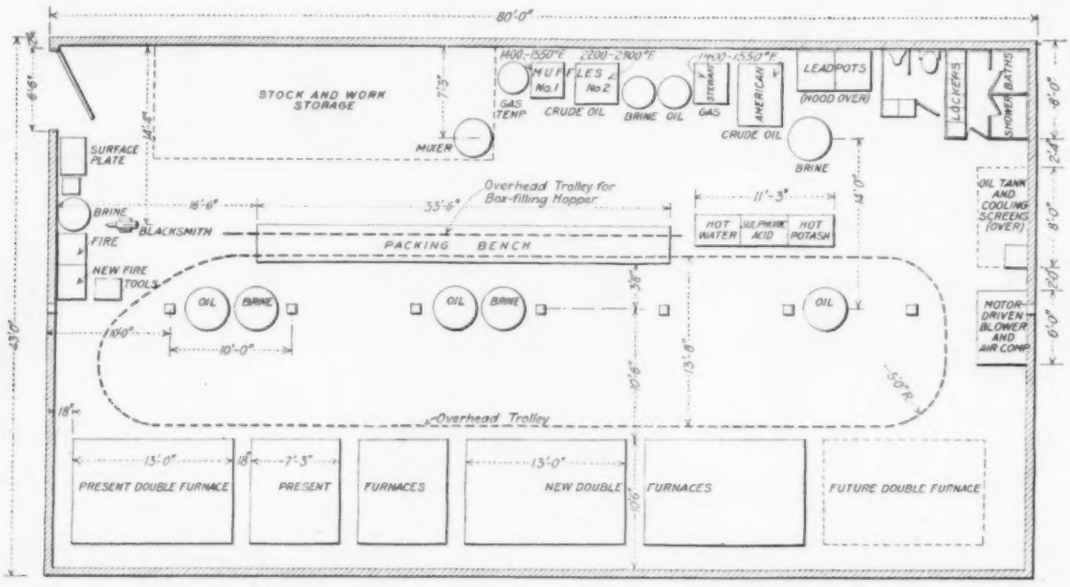


FIG. 1. LAYOUT OF THE HARDENING DEPARTMENT

FIG. 2. VIEW OF MUFFLERS AND LEAD POTS

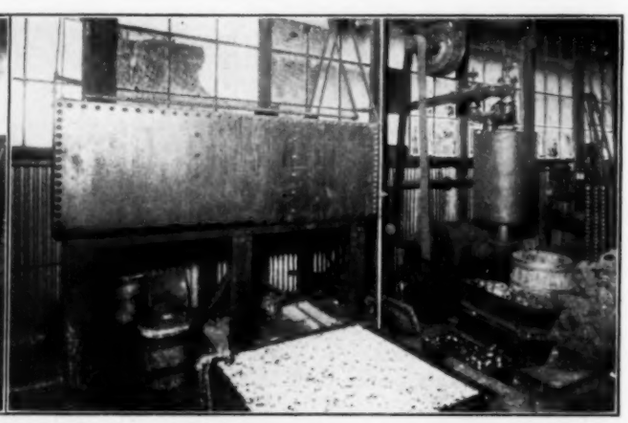


FIG. 3. VIEW OF OIL TANK AND COOLING SCREEN

A 5,000-Hp. Silent-Chain Drive

By John R. Allen*

SYNOPSIS—The waterwheels for this development were designed for a head of 42 ft. and a speed of 225 r.p.m. Owing to lack of head, their operating speed was 147 r.p.m. By connecting two wheels to the generator shaft through silent-chain and sprocket drive the speed of the generator was stepped up to 225 r.p.m.

At the time of the construction of the present temporary plant the Oxbow Bend power house of the Idaho-Oregon Light and Power Co. presented a peculiar engineering problem. The plant is located near Copperfield, Ore., at what is called the Oxbow Bend of the Snake River, about 60 mi. north of Huntington. It is 2½ mi. around the bend of the river, and the distance across the bend at the narrowest point is only 1,300 ft. The natural fall in the river in passing around the bend is 21 ft.

It was the original intention to build a dam across the Snake River, raising the water so as to give a head of 42 ft. at the power house. The tunnel across the bend was entirely completed, also the headgates at the entrance to the tunnel. The company having charge of the original construction had also purchased the waterwheels and two of the generators. The waterwheels had been purchased for a head of 42 ft., at which their speed would be 225 revolutions. At this point in the construction the company was forced to stop operations, owing to lack of funds, and the construction work was left for about three years.

In the meantime the company was placed in the hands of a receiver, who found himself very much handicapped for lack of power. There was also a possibility that if this power house was not completed the company's water rights in the Snake River would be forfeited. It was desirable, then, that this construction work be made use of as far as possible in building a temporary plant. It was at this point that I was called on to advise the company in regard to what could be done to obtain power from the Oxbow plant without expending any large sum of money. The amount of money available made it impossible to build a dam, as originally planned, or to buy new machinery. The problem was to use the construction work, the waterwheels and the generator already owned by the company and to combine them into an operating power plant sufficient for the purpose.

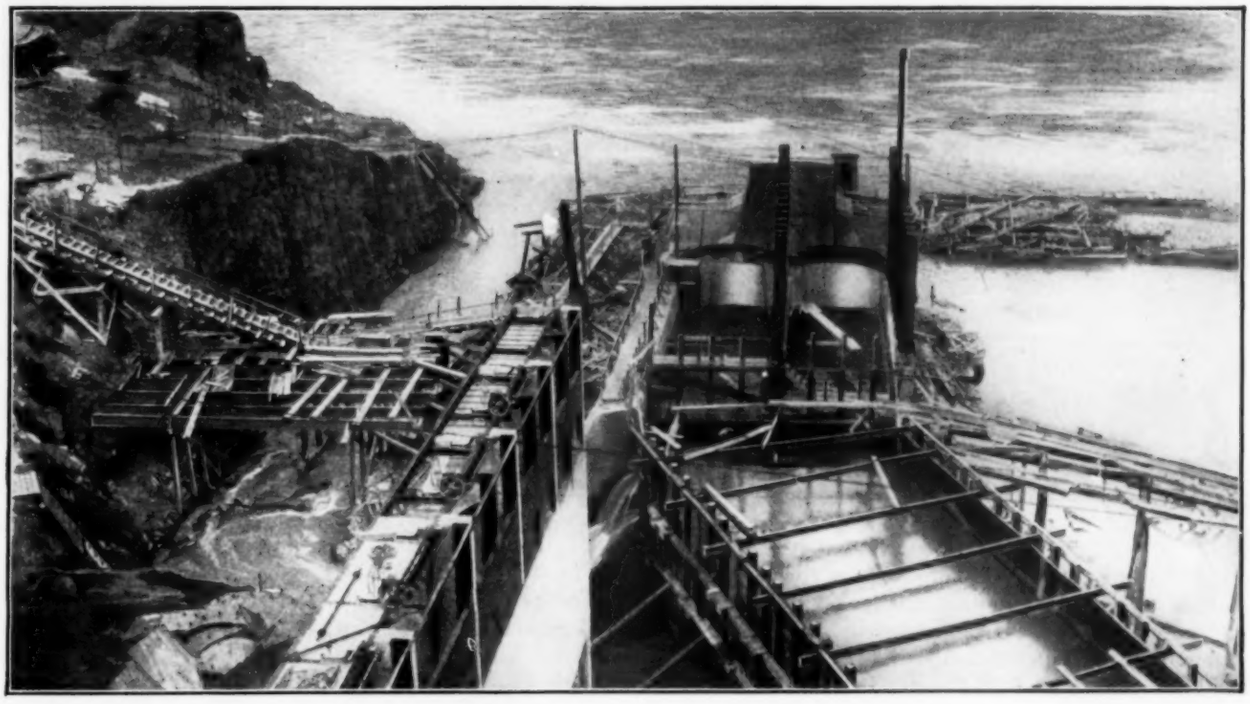


FIG. 1. A GENERAL VIEW OF THE PLANT

One of the difficulties was in the fact that the generator was designed for 225 revolutions and must be operated at that speed. The waterwheels at 21-ft. head would have a normal speed of about 147 revolutions and at the lower head would develop less than one-half the horsepower required by the generator. It was decided that, if possible, the experiment would be tried of driving one generator from two waterwheels, provided some form of geared drive could be employed to give the proper speed ratio between the generator and the waterwheels.

The first consideration was the use of large miter gears. These were seriously studied, but were given up owing to the difficulty that would be encountered in the gears being so large as to cut into the tailrace and prevent a proper discharge of water from the wheels. In addition, the expense of very large gears, such as

*Professor of mechanical engineering, University of Michigan.

would be necessary in this case, the shafts being 10 ft. 9 in. on centers, would be excessive. There was also suggested the possibility of using a crank and connecting-rod drive. This, too, was rejected owing to the many difficult problems involved in construction of this kind.

The third means considered was a silent-chain drive, which involved less expense and took up less space than any other form of drive proposed. In laying out the temporary plant it was found that it would be necessary to lower the wheels 5 ft. from their position as originally planned, in order to obtain a sufficient head of water over them in order not to draw air. The lowering of the wheels brought the waterwheel shaft very close to the floor of the power house, but by the use of a chain drive the sprocket wheels were reduced to so small a size that they did not cut into the engine-room floor to any depth. Previously to this time no silent-chain drive had been made for more than 1,250 hp., and it was with some misgivings that plans were made involving the transmission of 5,000 hp. The question of using so large a drive was taken up with firms making chains of this type and the contract was awarded to the Morse Chain Co., Ithaca, N. Y.

The hydraulic tunnel is 26 ft. wide, 26 ft. high and 1,300 ft. long. When the plant is in operation, the velocity of the water through the tunnel is about 7 ft. per sec., with a loss of head of about 1 ft.

A temporary tailrace of timber and steel was built to carry the water from the lower end of the tunnel to the concrete-steel penstocks in which are located the waterwheels. The wheels consist of four 48-in. wheels on a single shaft, there being two such sets.

A general view of the plant is given in Fig. 1. One set of chains and the generator are shown in Fig. 2.

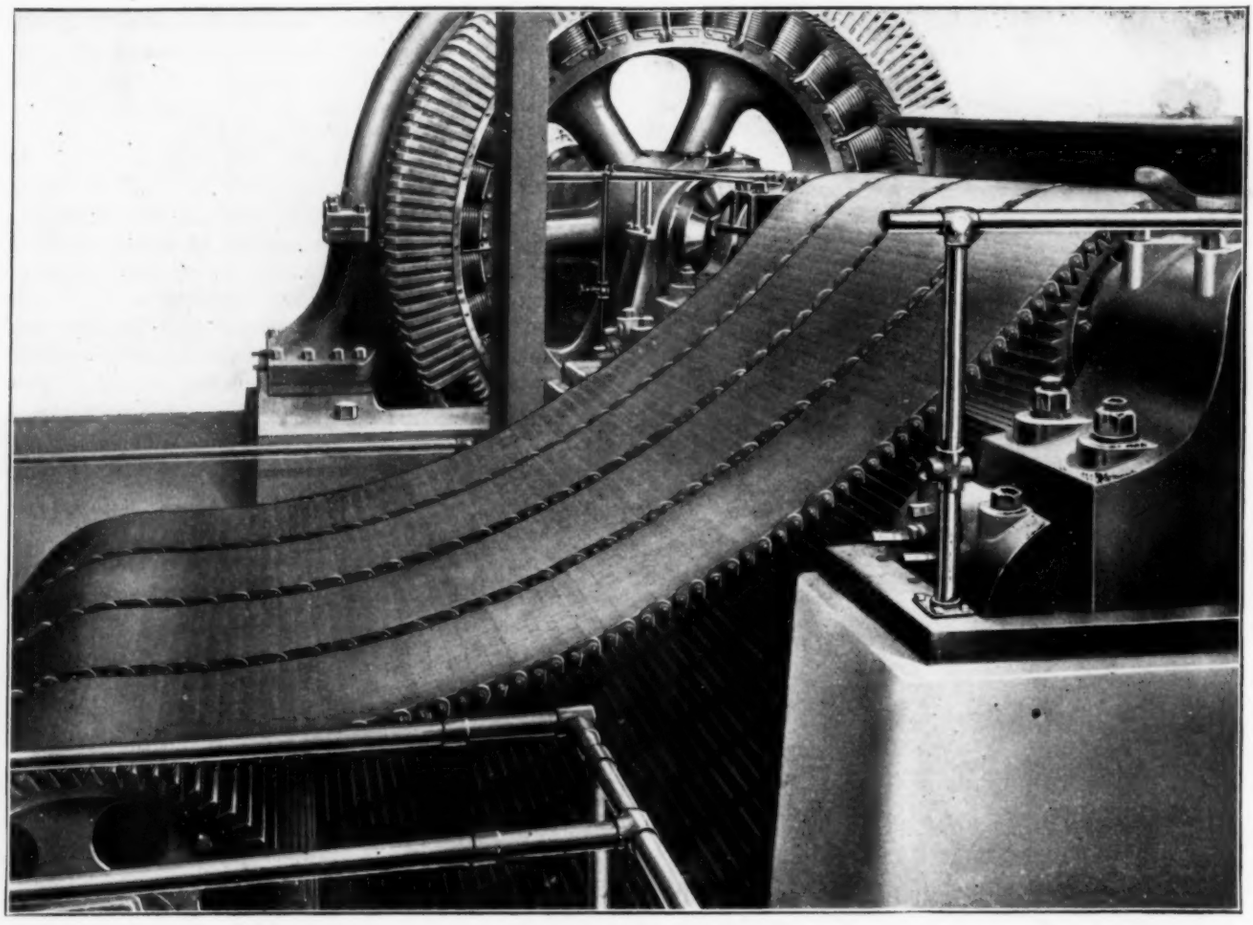


FIG. 2. ONE SET OF CHAINS AND THE GENERATOR

Fig. 3 shows a layout of the shafts, sprockets and chains. The power house is built of monolithic concrete construction up to the roof. The entrance is through the roof. This construction was necessary, as at times of high water the power house may be submerged to a depth of 8 ft. above the operating floor. One peculiarity

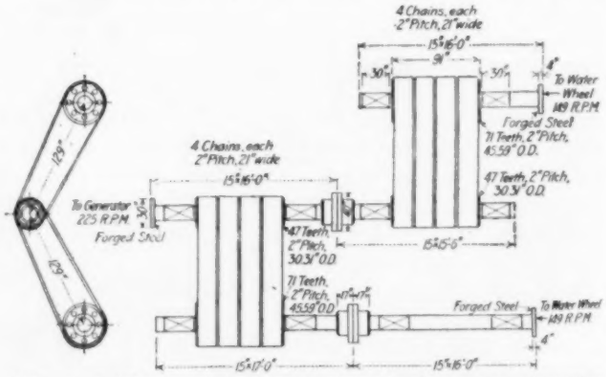

4 Chains, each 2" Pitch, 21" wide
To Water Wheel 189 R.P.M.
Forged Steel
71 Teeth, 2" Pitch, 45.58" O.D.
47 Teeth, 2" Pitch, 30.3" O.D.
4 Chains, each 2" Pitch, 21" wide
To Generator 225 R.P.M.
Forged Steel
47 Teeth, 2" Pitch, 30.3" O.D.
71 Teeth, 2" Pitch, 45.58" O.D.
Forged Steel
To Water Wheel 189 R.P.M.

FIG. 3. LAYOUT OF SHAFTS, SPROCKETS AND CHAINS

of this plant, however, is the fact that during periods of high water the level of the headrace rises about as much as the level of the tailrace, so that an approxi-

mately uniform head of water can be obtained at the wheels at all times.

The plant has now been in operation since September, 1914, and the only shutdown that has occurred has been due to ice trouble. The chains have given satisfaction. The operation of the chains is almost noiseless, and the sound made by the revolving armature of the generator is much more noticeable than the sound of the chain. In the drive there are eight chains, each 21 in. in width with a 2-in. pitch. The driving sprockets have 71 teeth, and the driven sprockets 47 teeth. The distance from center to center of the shafts is 129 in. The linear speed of the chain is 1,765 ft. per min. The main shafts are 15 in., and the main bearings are 15x30 in. Each sprocket is supported with a ring-oiling main bearing close to the sprocket at each end. From the first day upon which the plant started, the chains and operating mechanism have run without difficulty of any kind.

Building a Large Marine Engine Crankshaft

By R. M. Sherman

Each builder of large marine engines has his own opinion as to how a crankshaft should be made. While it is by no means difficult to build crankshafts, it is quite a different matter to produce one that, when finished, will be of 100 points excellence and that will render unfailing service. The heart of a ship is its propelling machinery; and if it has a reciprocating engine, the crankshaft is a basic factor of this heart. If the alignment of the finished crankshaft is poor, chronic trouble will soon develop and the exact source will be difficult to find. If the crankshaft does not run true and the pins are out of line with the shaft, it is almost impossible to line an engine up correctly, thus impairing the efficiency of the engine and increasing the fuel bill.

One of the many results of a faultily built and machined crankshaft will be hot bearings, which are a source of much annoyance to the engineer, besides interfering seriously with the performance of the engine, and which might result under certain circumstances in the loss of a ship. It is therefore of the utmost importance that the building and machining of a large marine-engine crankshaft should be intrusted only to mechanics who have had experience along this line.

Quite frequently the crank webs are delivered rough-forged in the machine shop. In such cases the first operation is to ascertain if there is sufficient stock left so that the webs will machine true to drawing size, which is determined by a sheet-steel templet. After this has been done, the crank webs are placed on a planer or miller and machined to the required thickness.

Since the web is a solid mass, as shown in Fig. 1, it would require considerable time to drill and bore it for the shaft and pins. To avoid this, two ¾-in. holes are drilled for a starting point, and then, with an acetylene cutting outfit, holes are cut about 2 in. smaller in diameter than the given size, thus allowing ample stock for finishing on the boring mill and taking care of eccentric cuts.

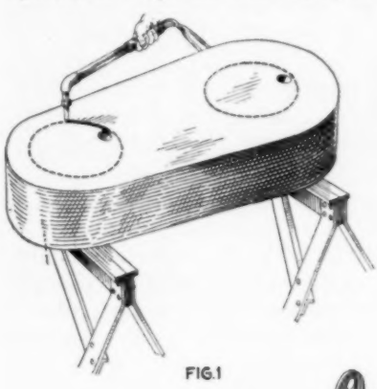


FIG.1

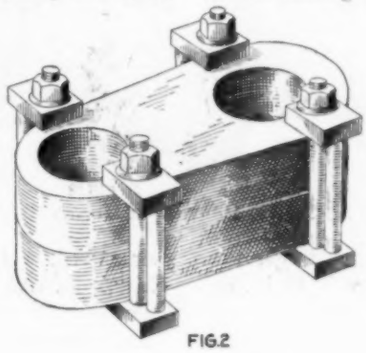


FIG.2

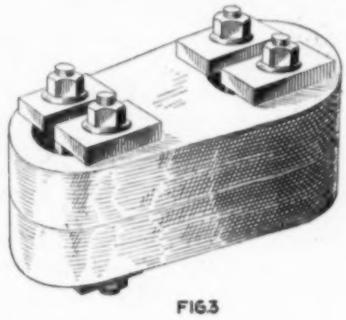


FIG.3

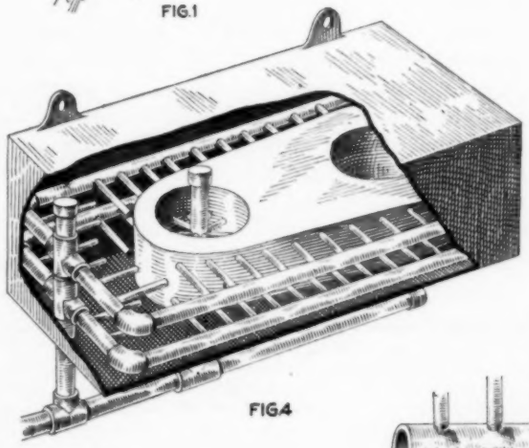


FIG.4

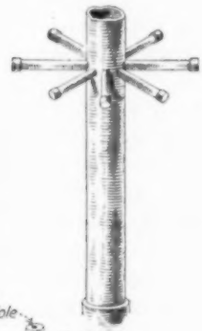


FIG.5

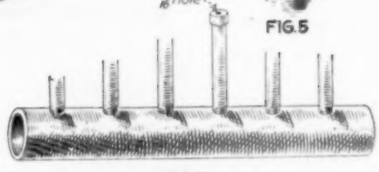


FIG.7

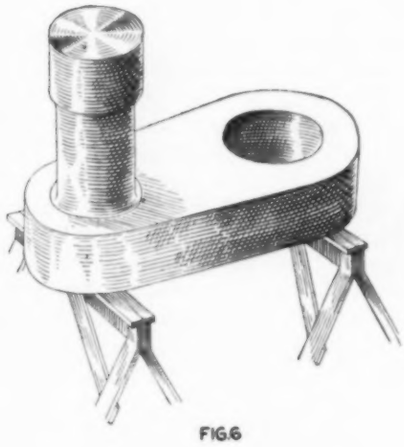


FIG.6

FIGS. 1 TO 7. THE CRANK WEBS AND HEATING DEVICES

All burrs are removed, after which the crank webs are carefully laid out, assembled in pairs and clamped rigidly together, as in Fig. 2. They are placed on a vertical boring mill, where they are accurately set and bored. Keyways are cut and clamps changed to the inside of holes

without disturbing the position of the webs, as in Fig. 3. The next operation is to slot the ends and sides parallel with the bore, or at right angles with the face. To obtain good results after the shaft has been shrunk together, this work must be done accurately. The webs are then disassembled, outside corners well rounded and a guide block fitted to the keyways in both the webs and the shafts.

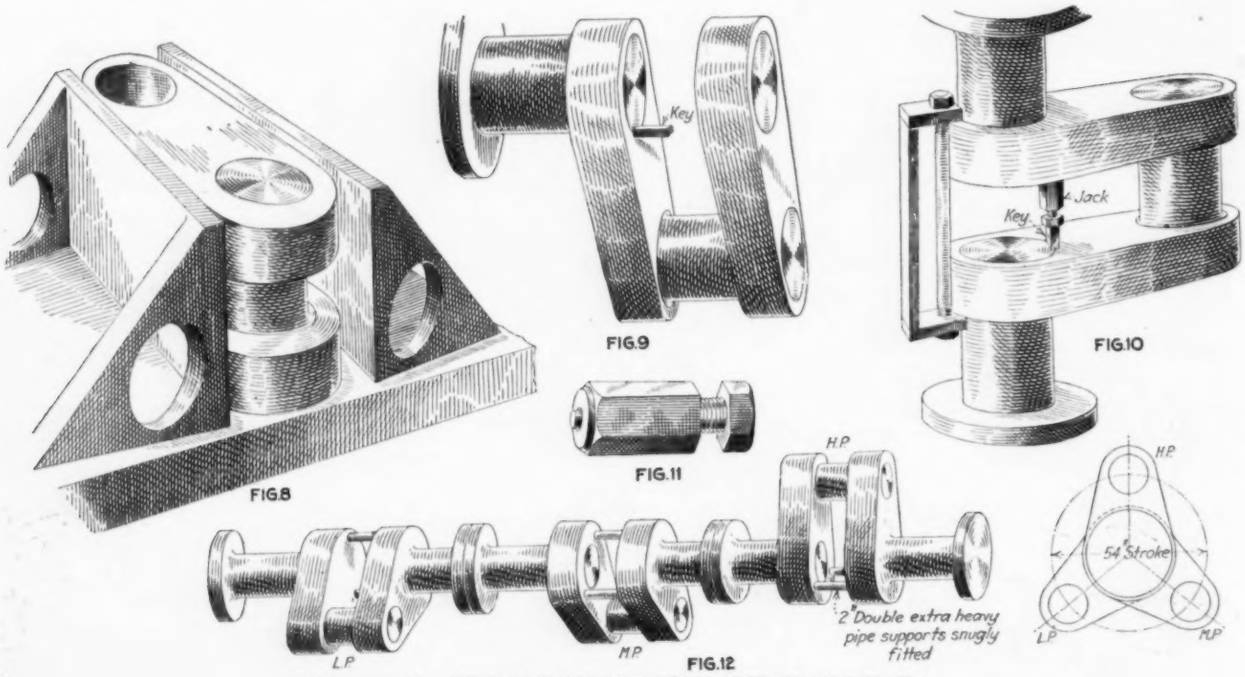
To produce a maximum grip of about 20,000 lb. per sq.in. on the crankshaft and pins, which from past experience has proved satisfactory, the pins and shaft are turned, for each inch of diameter, 0.001 in. larger than the bore of the web. In this case the bore is 18 in. and the shaft is turned 18.018 in. This practice, of course, applies to solid-steel shafts and pins and to webs made of forged steel. Should the shafts and pins have an axial hole through them, the allowance should be slightly increased, owing to the fact that the hollow shaft is more compressible.

To insure an even temperature, which is of vital importance, the webs are placed in a sheet-steel box made expressly for this purpose. The arrangement may be seen in Fig. 4. Gas pipes fitted with burners about 2½ in. apart, to suit the shape and size of the piece to be expanded, are placed in the box and around the web, as shown. In the center of the bore is fixed a vertical pipe that has a number of burners diffusing heat in all directions. The pipes are connected to the gas main, and the flow is regulated by the valve, as the case may require. The construction of the burners, which are simple and inexpensive, is illustrated in Figs. 5 and 7. With an outfit of this kind the temperature of the webs is quickly and evenly raised to any reasonable point.

The temperature to which crank webs should be raised in a shrink fit for clearance in assembling should not exceed 600 deg. F. and should be slightly less when handling facilities are good. When the web has been expanded sufficiently, the crankpin is placed in position and the temperature of the web reduced by an even application of cold water.

Having shrunk a pin in each web, as shown in Fig. 6, two angle plates are set on a platen, Fig. 8, and the other web heated and shrunk on. This operation insures accurate alignment for the shaft and pins, if all previous operations have been skillfully executed. As there is a keyway in both the web and the shaft, a guide block that has been previously fitted to both is used to keep the keyways and the shaft holes in line.

As will be seen from Fig. 9, one shaft is shrunk in each web, after which the keys are accurately fitted and driven



FIGS. 8 TO 12. BUILDING UP THE COMPLETE CRANKSHAFT

home with a heavy maul. The other section is then shrunk in, and the open ends of the webs are clamped, as in Fig. 10. As there is no room to use a maul, a screw-jack, Figs. 10 and 11, made especially for driving these keys, is used.

The crankshaft is then assembled, and supports are fitted between the webs, as shown in Fig. 12, after which the shaft is put in the lathe and tested. If all previous operations have been carefully handled, the assembled shaft should not run out more than $^1/_{64}$ in. The centers are drawn so that the alignment of the pins will be correct, and the shaft is turned to a snap gage.

The crankshaft shown is built so that each section is interchangeable. It weighs, when finished, 51,700 lb.

High-Grade Nonfluid Oils. It was pointed out in an article on good and bad lubrication presented in the "Journal" of the American Society of Naval Engineers, have all the advantages of soap lubricants but none of their disadvantages, and in addition they possess the property of adhering to metal surfaces with a force that is considerably above that possible with fluid oils. They are all of high viscosity and can only be fed drop by drop. In that they prove economical, as with ordinary oil a greaser can and frequently does squirt oil with a lavish liberality not only on the part needing it, but also on any parts adjacent. It is not to be supposed that this slow feeding is a disadvantage even where a bearing has run hot, as, owing to its clinging properties, it films immediately on reaching the moving part and so forms an ideal lubricant. Nonfluid oils, also, will not gum, and they can be used without risk of clogging in central distribution systems provided the oil tubes are of sufficiently large internal diameter to permit of the oil flowing.

Effect of Peace on the Demand for American Machine Tools

SPECIAL CORRESPONDENCE

SYNOPSIS—A study of the conditions in European markets, with an attempt to forecast the after-war demand for machine tools. It is estimated that some $22,000,000 worth will be required at once.

While fighting is still going on in Europe the possibility of a return of peace already begins to influence commercial conditions, especially in the neutral markets. Exporters and importers are beginning to maneuver for position. The change from the conditions of war to those of peace will not be easy. It must be realized that the struggle has cut deeply into the economic life of all the nations involved, including the neutrals. It is therefore necessary to begin early, so as to shorten as much as possible the period between the end of war and the reëstablishment of normal conditions.

It appears that the American machine-building industry, especially the machine-tool industry, will play a considerable part in the economic upbuilding of Europe after the war, and it therefore seems necessary that the representatives of that industry, both at home and abroad, should be fully conversant with all the preparations made in Europe with a view to coming peace, so as to be able to equip themselves for any emergency likely to arise.

The effects of the war on the European machine-tool industry have been of various kinds. In the countries of the Allies, where a large importation of American machines has taken place, conditions must be different from those in Germany, or again from those in neutral markets. Consequently, in each case different steps will have to be taken, both to reëstablish connections and to select the machines to be supplied.

THE CONDITIONS IN GERMANY

To start with Germany, the effects of the war on the machine-building industries in that country have already been explained in the *American Machinist*. It seems only necessary to say a few words about those points that will interest the importer of American machine tools. Germany was a very good customer for American machine tools before the war. Her engineers realized early the advantages offered by American machines and have made good use of such machines. American machine tools were imported into Germany to the value of about $2,000,000 a year; the exact figure for the year before the war being $2,167,240. Allowing a depreciation of about 10 per cent. on such machines, one would estimate a total value of American machine tools existing in Germany before the war at about $11,000,000, or even more. There is, furthermore, no doubt that Germany has been able to secure American machine tools from other sources than America since the outbreak of the war, which may have raised the American machine-tool equipment in Germany to a value of about $14,000,000. Probably for the years of the war a much higher depreciation of machine tools will have to be accounted for than the usual 10 or 15 per cent., and 25 per cent. is possibly not too high. Thus the book-value of the American machine tools installed in German plants at the end of the second year of the war would be about $10,500,000.

A number of the older machines may have become entirely unsuitable for use and will go to the scrap heap after the war. This, however, may not impair the usefulness of the great majority in a time like the present, where every machine is used to its utmost capacity. Depreciation and new demand resulting from depreciation and ultimate destruction, however, can have only a comparative meaning if applied to foreign trade. Even during the war American machine builders have seen new competition growing up in Germany. It is said that several firms have taken up the manufacture of machine tools that formerly had to be imported. While the manufacture of these tools was unprofitable as long as they could be imported, it became profitable, however, the moment there was no other way of getting them than by making them at home. This competition may impair the probable demand for American machine tools after the war as far as Germany is concerned.

On the other hand, there are a number of reasons that speak for an increase in the demand. First, there is the fact that Germany has been accustomed to the buying of machine tools from American makers at a fairly high rate and that she has been unable to buy for nearly two years. Second, there is the certain lack of machine tools of all kinds imported or built at home which will become more and more pronounced when the war is over and normal conditions begin to rule again. Germany, like all the other countries, has gone through a period of national economy; and while saving may still be a virtue after the war, there are certain things that cannot be left undone. German manufacturers may think it wise to buy from abroad, in this case from this country, rather than to wait until the needful supply can be covered by the manufacturer at home. All of which would mean not only a return to the former import figures, but possibly an increase in the demand.

Finally, there is the influence of all who are interested in a speedy reopening of trade relations between this country and Germany after the war, which should not be underestimated as a powerful factor in bringing about a reëstablishment of the foreign trading connection. It appears, therefore, that the sales of American machine tools in Germany after the war may be very heavy.

CONDITIONS IN AUSTRIA-HUNGARY

Austria-Hungary, to continue with the Central powers, has not been a very large customer for American machine tools, buying on the average only about $250,000 worth a year. Part of the machines sold to Germany may have found its way to that country. The economic conditions of Austria-Hungary, since the outbreak of the war, however, have been about the same as those of Germany. And even if Germany should have been able to secure American machine tools in small number it seems practic-

ally impossible that Austria should have been able to do so. Moreover, the country has been in the habit of buying large numbers of German machines every year, a field of supply that must have been fairly limited during the last two years. In 1913 alone Austria bought $3,110,000 worth of German machine tools. Austria herself is building certain classes of machine tools, but the figure given above shows how largely she has been depending on her neighbor. It is doubtful whether Germany will, after the war, be able to take care of all the business of her present ally, and Austria may be compelled to go for her supply to other markets.

Both countries are making extensive preparations for the coming of peace. One of the most difficult problems to be faced is the reëntering of the small artisan, who has been serving as a soldier, into the economic life of the community. He will need capital, and the large number of invalids will have to be supplied with suitable machines for carrying on their trades. This will affect the small machine-building industries and may bring about a large demand for small machine tools and even automatic machines. The extent of this cannot be foreseen now. The fact in itself, however, should be noted. Municipal money will be used for the purposes of reëstablishing these artisans.

Conditions in the Balkan States

Bulgaria, the third in the number of the Central powers, has never been a large customer for American machine tools and most likely will not be so after the war. Austria, Germany, and to some extent Italy, have taken care of the requirements of that market and most likely will continue to do so. The same may be said for Turkey.

Servia, Montenegro and Greece have also shown a decided favor for machine tools from Germany, Austria and Italy. The continuation of that business will depend entirely upon the peace that will be made. Greece may continue to buy from Germany and Austria, while a change is predicted in the attitude of Servia and Montenegro. The conclusion of the treaty between Germany and Rumania seems to indicate a continuation of the commercial relations between these countries that will assure to Germany a sale of machine tools to Rumania of about $140,000 a year.

Conditions in Great Britain and France

Turning to the group of powers commonly called the Allies, England has been by far the largest customer for American machine tools since the outbreak of the war. She bought from this country in the year before the war $3,178,000 worth of machine tools, roughly $1,000,000 more than Germany. England has had the advantage of being able to secure as many machines as she wanted, and it would not be astonishing if more had been bought than were actually needed. It may be that after the war England will not only quickly return to her peace requirements, but may even buy less until the machines bought during the last two years have been assimilated by her industry under peace conditions. The probable decline, therefore, in the imports of machine tools coming into England from Germany and averaging yearly a value of $1,500,000 before the war most likely will not have any material effect on the English orders from American makers, at least for the first two or three years.

France has also been buying on a considerable scale in this country since the outbreak of the war. The condition of France, however, is different from that of England. While England in increasing her equipment has used existing possibilities, France had to create a new industry, necessitating machine tools to a value of about $10,000,000 and more a year. France has always been an enormous importer of machine tools even under normal conditions. Germany alone used to supply her with $3,000,000 worth a year while this country sold her $1,771,000 worth the year before the war. All in all, France imported yearly about $10,000,000 worth of metal-working machine tools. Considering this figure, and that she has had possibly very few machines from England since the outbreak of the war, and none from Belgium and Germany, the present requirements cannot be called at all excessive. In fact, it is astonishing that France should have been able to get along with so small a supply.

Further, one will have to keep in mind that the main districts of the French machine industry are at present in German hands and that according to reports the machine-building plants have been depleted of their stock both by the retiring French and the in-coming Germans. Therefore there is every possibility that France after the war not only will continue to buy machine tools at the present rate, but even may increase her orders until her machine-building industry has completed its equipment.

Belgium, another of the Allied nations, has been practically in the hands of the invading armies and has ceased to be a buyer of machine tools since the beginning of hostilities. The little country has been a very good customer for American machine tools for many years and it looked very much as if the imports would reach the $1,000,000 mark during the year before the war. The record was suddenly interrupted during August of 1914. Belgium has imported about $2,500,000 worth of machine tools every year, the majority coming from Germany. In addition, she has been a manufacturer of such tools herself. As it is said that the country is practically emptied of metal-working machines, her requirements for such machines may be considerable after the war. It is certain that America will have a large part of the orders. The likely demand for machine tools of the character of those as a rule exported by America should be somewhere around $15,000,000, or even more.

Conditions in Italy and Russia

The conditions in Italy are complicated, seeing that the country while having war with Austria-Hungary, is technically at peace with Germany, even to the point of occasional commercial intercourse. With an open sea, she has been able to buy as many machine tools as she wanted, and considering that the industrial expansion of the country after the war most likely will go forward on the same scale as before, there is very little reason why the demand should become larger than it has been. About two-thirds of the machine tools imported into Italy came from Germany.

Russia also has been able to buy all the machine tools she required. It is said, however, that the ports of Russia are full of goods and that it is extremely difficult to move them to their destinations. Russia takes an exceptional position among the Allied nations. She has always been a large importer of industrial products and will continue to be so after the war. This tendency will be counterbalanced by the desire of her rulers to create a Russian industry, independent from foreign imports. So, what-

ever the outcome of the present war, Russia will drive slowly in the direction of closing her frontiers against foreign trade. She will attempt to make many things she is buying now, including many of those supplied at present by America and even her present allies. The building up of an industry cannot be accomplished without the assistance of machine tools of all kinds, and in whatever she may contemplate for the future there will be an accompanying policy of encouragement of the importation of first-class machine tools. Those tools may still come from Germany, but they will come as well in increasing number from America. It is almost certain that the demand will set in right after the declaration of peace. The $1,369,000 worth of American machine tools imported into Russia in the year before the war will easily be doubled when normal conditions prevail.

Conditions in the Neutral Nations of Europe

The few remaining neutral nations of Europe have played a peculiar part during the war. Unable to keep themselves entirely out of the struggle, suspected by all belligerents and compelled to spend fairly large amounts for military purposes, they have nevertheless been able to pile up a comfortable fortune. The available figures show that they have been able to secure about one-half of their actual needs of machine tools, and the business was practically left to American exporters. To take the case of Holland, that country has bought more machines from America since the outbreak of the war than in normal times; on the other hand, the cessation of imports from Germany must have left the country with a deficiency over former years. Holland used to buy machine tools at the rate of $800,000 a year from Germany. Sweden, which bought about $500,000 worth, Norway with an importation of $215,000 and Denmark with imports of about $250,000 worth of machine tools from Germany during one year, have also been left with a deficiency, notwithstanding increased imports from America. To supply this need Germany alone would have to take over orders amounting to about $3,000,000 for immediate delivery, which most likely she will not be able to do. To those four nations should be added also Switzerland, which received machine tools from Germany before the war at the rate of about $750,000 worth each year.

Spain and Portugal both have increased their American orders during the last months; Spain especially has been a good buyer. With the return of peace this tendency should become more pronounced. During the year before the war the American exports of machine tools into Spain were valued at $110,000.

Provided that no great changes take place in Europe until peace comes, and all indications point to the contrary, this will be about the situation in the machine-tool business. Changes will be more pronounced after the war and it will take some time before the market has settled down to new permanent conditions. Should the war end before the New Year this might mean a likely immediate demand for machine tools that can be supplied by America of a value of about $22,000,000. American machine-tool manufacturers have little to fear from a sudden break in the market owing to an unexpected peace, at least as far as European exports are concerned.

As the European manufacturers, especially those in England and Germany, will have plenty to do for at least two or three years, a theory that seems to be accepted by all conversant with economic conditions in Europe, there is also little danger that European machine-tool builders will feel inclined to cheapen their goods. It is said that the higher costs of producing, made up of higher wages, higher cost of materials and higher general expenses, as taxes, etc., will even compel manufacturers to keep up a higher standard of prices than existed before the war.

Taper Attachments for Use on Turret Lathes

By William Baumbeck

When one observes in descriptions and illustrations of shrapnel manufacture, which are now appearing in most mechanical papers, the accuracy obtained on turret lathes, one wonders why machine shops have not long before this used turret lathes for finished and accurate work on large and complicated pieces. Most shops have employed turret lathes as roughing machines for their more intricate work, such as bevel gears, cylinders, pistons, etc., doing only one or two operations and finishing the pieces on engine lathes and grinders.

No doubt, a good many shops have had the same reason for this practice as was given by a large Western factory; that is, the work required very close tolerances, special tapers and shapes beyond the capacity of any turret lathe, therefore making it impossible to machine successfully.

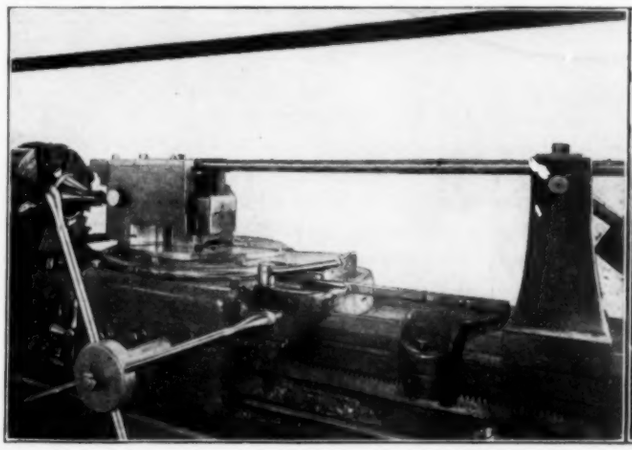


FIG. 1. TAPER-TURNING ATTACHMENT AT WORK

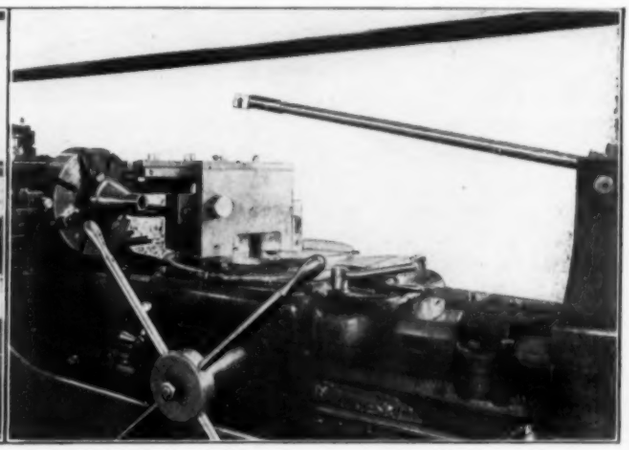


FIG. 2. DISCONNECTED AND TURRET SWUNG

One wonders how quickly the manufacturers of shrapnel devised special and complex tools and fixtures for use on turret lathes for various involved operations on shrapnel. Why not give this same consideration to special tools for general manufacturing purposes?

The matter of finishing on turret lathes some of the perplexing pieces for ordnance work has been carefully studied during the past two years at this Western factory, and some very interesting and ingenious fixtures were devised and successfully used in a good many operations, such as boring from 25-deg. to 45-deg. taper holes, facing large bevel gears complete and boring circular holes.

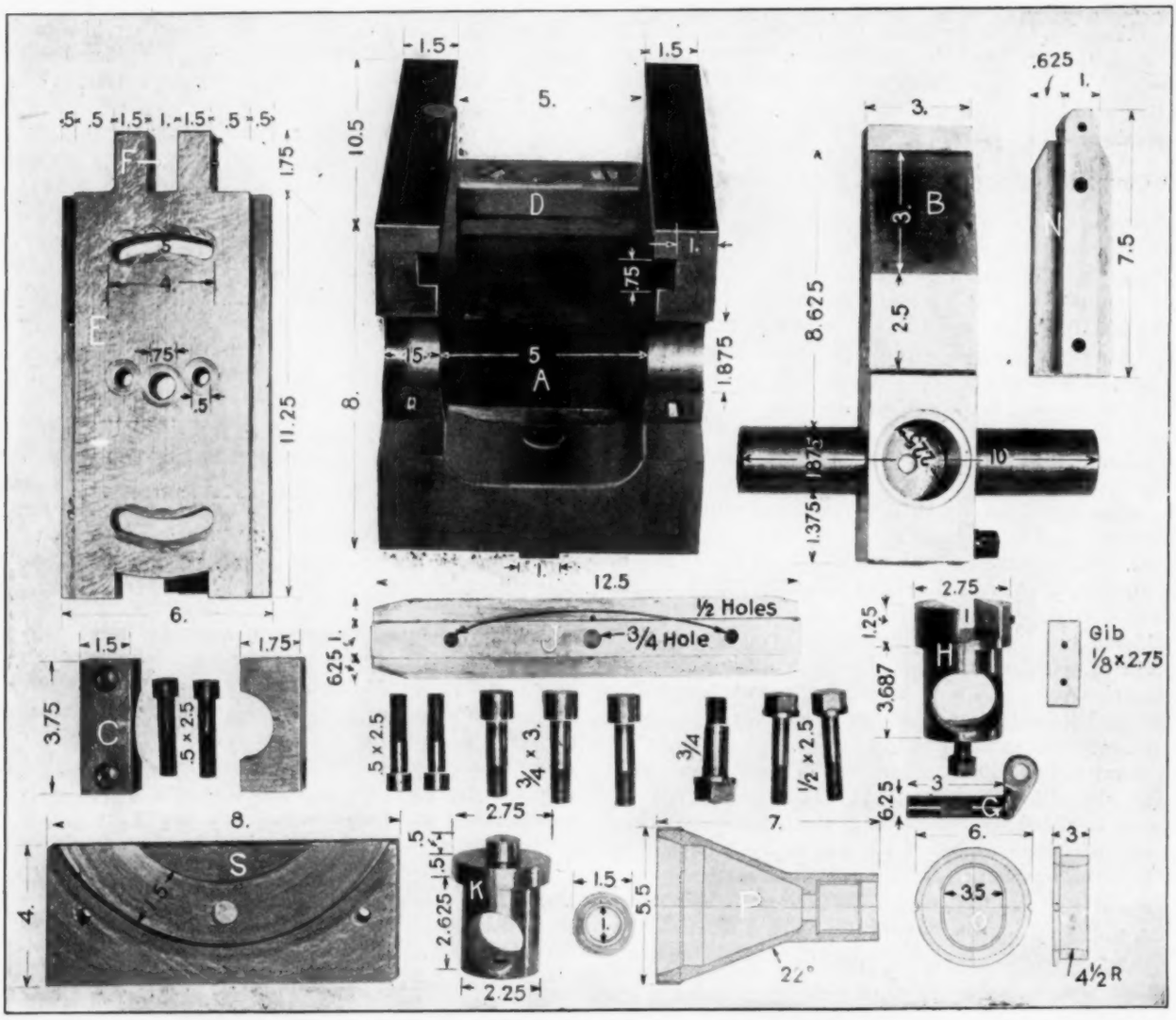


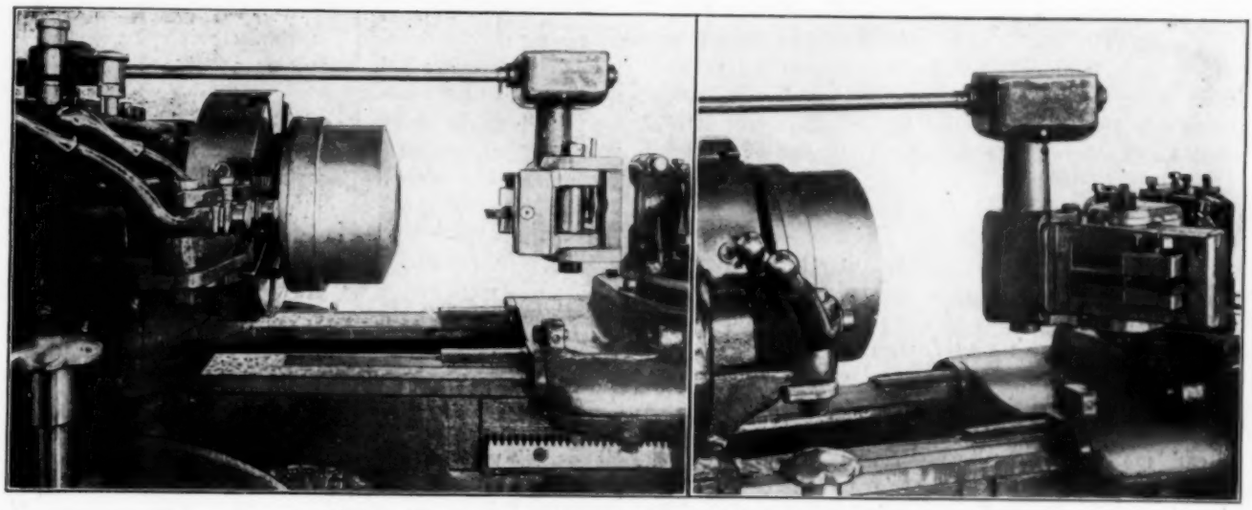
FIG. 3. DETAILS OF THE TAPER-TURNING ATTACHMENT

Fig. 1 illustrates a fixture for boring and turning tapers, as well as for form-turning and boring. It is mounted in working position on a Jones & Lamson turret lathe. Fig. 2 shows the tool swung on the turret and disengaged from the bar, which is held by a bracket fastened on the end of the lathe. A counterbalance helps the operator disengage the bar quickly and keep it out of the way during other operations of the turret.

Fig. 3 shows the tool in detail. The base *A* is fastened to the turret in the same manner as a regular turning-tool holder, with bolts in holes in the turret. The tool holder *B* is held in the case by two caps *C*, in an easy sliding fit. The bracket *D* holds the tool holder at the rear end, preventing any side cramping of the holder. The stud *H* is fitted into a hole in the tool holder. The taper-bar plate *E* slides in the top of the base *A* and is held by gibs. The slot *F* is for inserting the driving bar and for the lockbolt *G*. The center hole is for holding the taper bar *J* to the plate, and the circular slot is for clamping the bar to the plate after the desired angle is obtained.

A boring bar is inserted in the tool holder to operate the tool. The taper bar is set to the desired angle and bolted to the taper-bar plate. The bar is inserted in a slot in the taper-bar plate and locked with a lockbolt Then the turret is moved forward, and the tool begins to cut. Very accurate boring and turning will be secured, as there will be no lost motion in either the tool holder, when sliding, or in the taper wedge. Turning to within 0.0005 in. in either the forward or the backward movement can be secured.

For turning special formed surfaces or for boring circular holes a form plate *S* is fastened to the taper-bar plate *E*. A gib stud *K*, with a loose hardened collar to move in the form plate, is inserted in the tool holder, and



FIGS. 4 AND 5. TWO VIEWS OF THE ANGULAR TURNING

the same accurate results are obtained as in doing taper work with this tool.

Turning or boring to 25-deg. taper and 12 in. long can be done with a taper bar 14 in. long; and a taper up to 40 deg. and 5 in. long can be secured by making a shorter bar as *N*, to work inside of the base.

Figs. 4 and 5 show a tool for facing operations that formerly had to be performed with a compound rest and

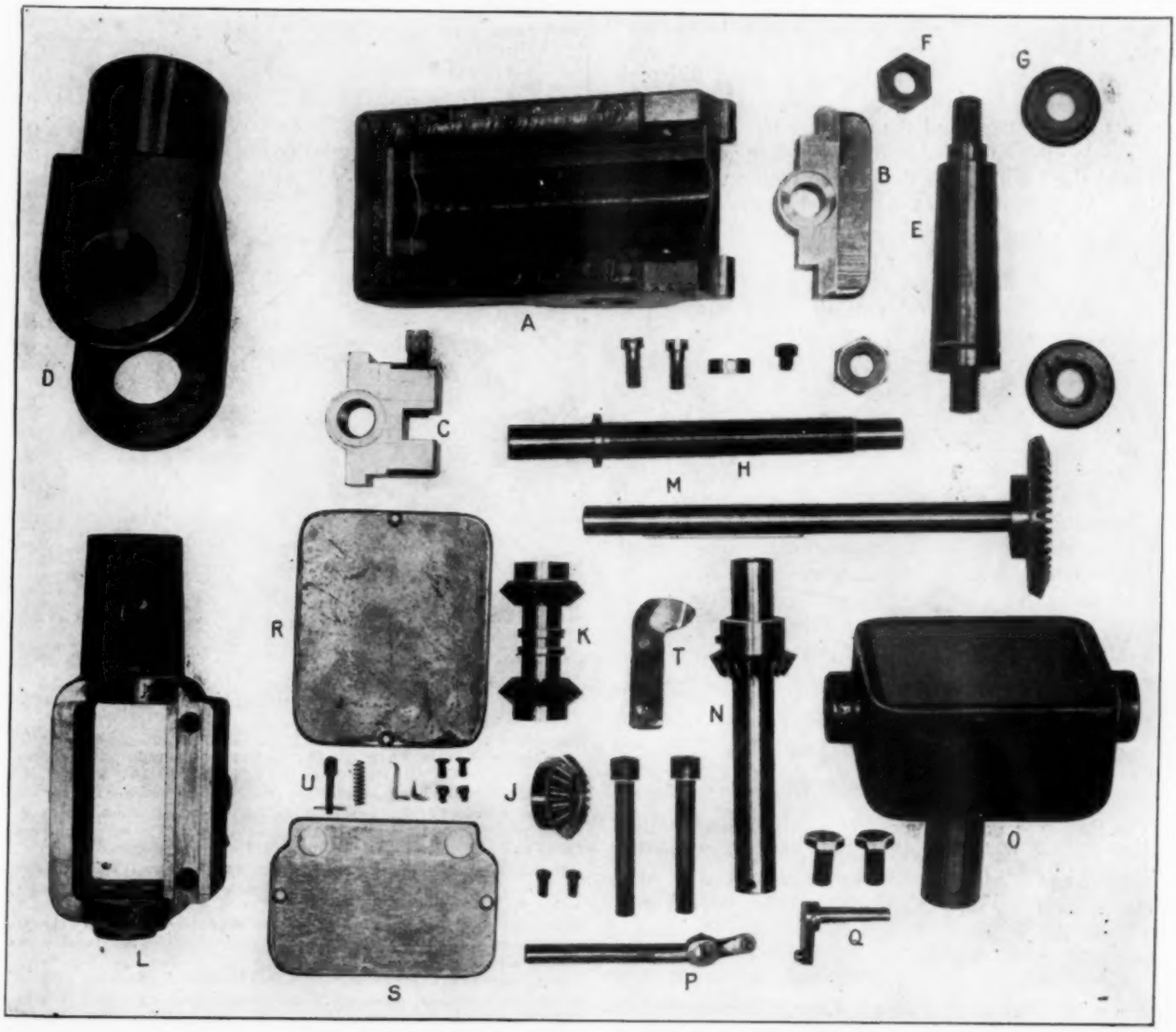


FIG. 6. HOW THE ANGULAR TURNING TOOL IS MADE

could not be done on any turret lathe except with broad facing tools. This tool is more complicated in design, but a wider range of angle work can be obtained, as the tool can be swung to a 45-deg. position. It is driven by the driving bar attached to Jones & Lamson turret lathes with their threading attachment. The parts of the tool are shown in Fig. 6.

The tool-carriage swivel *D* is clamped in the round-hole holder of the turret lathe. The tool carriage *A* is attached to the swivel *D*, clamped tightly in any position by the clamping stud *E* and locked by nuts and washers *F* and *G*. The upper ear of the swivel is graduated in degrees up to 45 each way from the center. A small indicator point fastened to the tool carriage will show at a glance the angle that the tool has been moved.

The tool-holder slide *C* is fitted into a T-slot of the tool carriage *A*. The feed screw *H* is held by two bronze bearings *B* screwed to the tool carriage. The bevel pinion *J* is attached to the feed screw with a taper pin. The sliding-gear case *L* is bolted to the end of the tool carriage. The driving shaft and bevel gear *M* are attached to the bevel-gear case box *O* and then passed through the top of the sliding-gear case into the sliding gear *K* to the bottom bearing in the case. The sliding gear *K* is driven by a key in the driving shaft. The bevel-gear case box *O* is held to the sliding-gear case by a circular gib and lock-screw. *R* is the cover plate and *T* the tool used.

The sliding gear *K* can be moved to three different positions (forward, neutral and backward) by the bell crank *Q* the handle *P* and the plungers *U*. These plungers are located on the side of the sliding-gear case *L* and hold the handle *P* in the desired position by spring action. An indicator point is fastened to the tool-holder slide *C*, with danger-mark lines on top of the tool carriage, so that the operator will not let the tool holder jam against the bearings.

To indicate the powerful cutting strength and easy working of this tool, a ¼-in. wood pin can be used for driving. It is used on a driving shaft for a ⅜-in. deep cut, $\frac{1}{32}$-in. feed, 4 in. long, on hard cast iron. The tool cuts in either direction.

The work, as shown at *P*, Fig. 3, is completed in one set-up in the lathe—finishing outside turning and finishing inside boring. The advantage of such a tool on operations of this kind can easily be appreciated.

Boring circular holes, as shown on the piece at *O*, Fig. 3, may not be needed in many manufacturing operations. However, where similar or formed surfaces are required, a tool like the one illustrated would pay for itself in a short time, as the slight cost of making a forming plate *S* would only be necessary for a new job.

Engineering Foundation Plans Research Federation

The Engineering Foundation (the initial endowment of which was received last year from Ambrose Swasey of Cleveland and is administered "in the interest of scientific research and the good of mankind" through the engineering profession by trustees from the national Societies of Civil, Mining, Mechanical and Electrical Engineers) has decided to offer its services to the National Academy of Sciences of the United States "to accomplish the federation of all the research agencies of the nation, governmental, university and private, with the object of encouraging the application of scientific principles to American industries and the employment of science in the national defense."

It has been decided to spend from $8,000 to $15,000 per year on a competent executive secretary to assist in the above organization. An important addition to the financial resources of the Foundation has been made by Mr. Swasey.

Machine-Tool Shipments from Port of New York

	1916		
	First Quarter	April	May
Argentina	$36,527	$10,103	$3,990
Australia	131,290	54,365	93,148
Australia and Tasmania	213,891	.....	.....
Barbados	26	.....	255
Bermuda	64	.....	56
Bolivia	.....	.....	10,253
Brazil	6,389	212	.....
British East Africa	61	.....	67
British South Africa	19,564	.....	.....
British West Africa	3,894	.....	.....
British Honduras	.....	.....	.....
British East Indies, other	.....	.....	4,990
British West Indies, other	4	.....	.....
British India	10,013	11,941	3,404
British Guiana	6	.....	234
Canada	.....	.....	.....
Chile	5,542	13,313	12,876
China	2,729	2,787	2,425
Colombia	832	1,135	1,164
Costa Rica	1,395	711	146
Cuba	20,284	18,962	18,199
Danish West Indies	8	.....	1
Denmark	26,254	1,604	18,328
Dutch East Indies	2,769	.....	.....
Dutch West Indies	2,702	.....	.....
Dutch Guiana	.....	.....	.....
Ecuador	591	202	1,343
Egypt	178	.....	.....
England	4,471,340	1,482,903	2,067,289
Finland	11,133	2,442	306
France	3,108,251	1,699,746	1,720,112
French Azores	.....	55	.....
French China	.....	.....	.....
French Oceania	3,061	.....	.....
French West Indies	.....	.....	.....
Gibraltar	1,015	.....	.....
Guatemala	425	64	182
Greece	544	580	6,317
Haiti	.....	24	737
Honduras	729	1	279
Hongkong	47	.....	.....
Ireland	552	.....	.....
Italy	1,539,410	605,291	797,572
Jamaica	72	.....	.....
Japan	98,839	5,617	35,785
Mexico	12,117	58,485	13,999
Newfoundland and Labrador	3,196	125	28
Netherlands	65,146	30,428	28,293
New Zealand	39,804	1,711	7,229
Nicaragua	36	.....	22
Norway	89,898	19,170	25,812
Panama	20,211	15,688	8,011
Peru	7,130	289	20,555
Philippine Islands	934	47	17
Portugal	482	267	13,635
Portuguese Africa	1,397	.....	.....
Russia in Asia	30,174	23,636	1,851
Russia in Europe	671,986	81,177	3,307,800
Salvador	71	1,072	65
Santo Domingo	749	129	1,219
Scotland	108,558	51,446	90,913
Spain	337,155	17,851	71,776
Straits Settlements	1,787	.....	66
Sweden	29,852	452	28,135
Switzerland	9,938	.....	2,114
Trinidad and Tobago	500	.....	42
Uruguay	1,434	144	551
Venezuela	3,083	446	470
Total	$11,156,916	$4,214,621	$8,422,613

Testing Metals Through the X-Ray was made the subject of a paper read recently before the British Institute of Metals. This application was thought to possess interesting and practical possibilities, particularly in the case of copper castings, since pure copper, when at a high temperature, absorbs gases from the air, thereby rendering likely the formation of blowholes. When making these castings a small quantity of phosphorus, tin or zinc is usually added as a deoxidizer. Blowholes, however, are always to be guarded against, and in order to study their occurrence the author made some X-ray experiments upon a thin casting of pure copper, using a Gundelach X-ray tube. The blowholes were readily discerned by faint spots, but had there been employed a more powerful source than the ordinary strength X-ray used, such as the Coolidge tube, it is thought certain the radiographs would have been sufficiently distinct for precise deductions.

Making the 4.5-In. Howitzer Cartridge Case--II*

By Robert Mawson

SYNOPSIS—In this section the operations are continued from the final drawing to the machining of the case. The various machines used are shown by illustrations, and the special attachments, gages and similar small tools are presented in detailed drawings.

After the final drawing operation the cartridge cases are taken to the lathe, Fig. 28, and trimmed to 4 in. in length. The same tools are again used, as shown in detail in Fig. 29, with the exception that there is another guide chuck to suit the diameter of the case and the length it is to be trimmed. The rate of production for the operation is 270 per hour. This operation is shown in diagrammatical form in Fig. 36. The cartridge cases are washed for about 1 min. in a solution of hot water and caustic soda, to clean them. A view of the tank, with tray holding 16 cases, is given in Fig. 37. The tank held in position ready for receiving shells to be dipped in the solution of hot water and caustic soda is shown in diagrammatical form in Fig. 38.

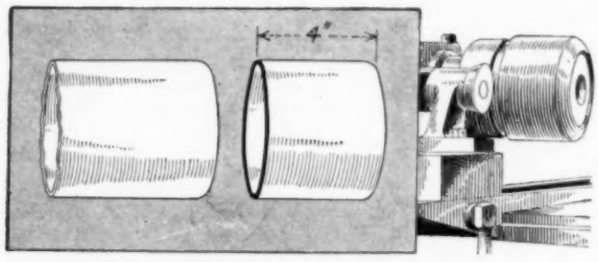


FIG. 36. OPERATION 17: TRIMMING

Machining Used—Special high-speed lathe with chuck and trimming attachment.
Production—270 per hr.
References—Figs. 28, 29 and 30.

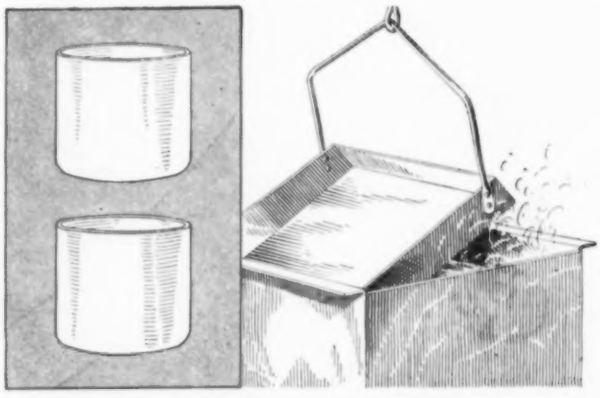


FIG. 38. WASHING OPERATION

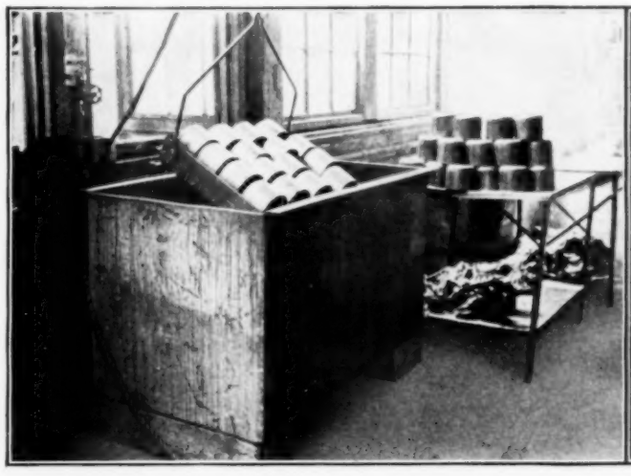


FIG. 37. TRAY WITH CASES FOR WASHING

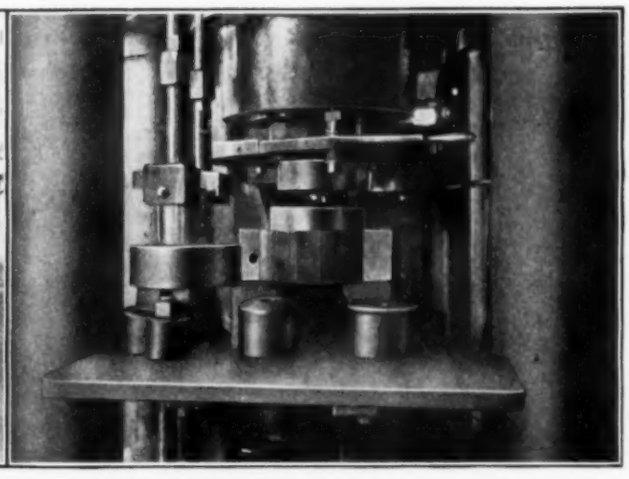


FIG. 39. HYDRAULIC HEADING PRESS

The next operation is the heading. This work is performed in both hydraulic and power presses. A view of the hydraulic press is seen in Fig. 39 and of the power press in Fig. 40. The operation is divided into first and second heading. Details of the attachments fitted to the hydraulic press are illustrated in Fig. 41. The die used in the hydraulic press is illustrated in Fig. 42. The die for the power press is shown in Fig. 43. The punch for both the hydraulic and the power press for the first heading is seen in Fig. 44. The knock-out used in the hydraulic is shown in Fig. 45 and that for the power press in Fig. 46. For the second heading the same tools are employed, with the exception of the punch, which is illustrated in Fig. 47. The first and second heading operations are given in diagrammatical form in Fig. 48.

The cases are then trimmed to 3½-in. length in a manner similar to that previously described. This operation is performed on the machine seen in Fig. 28 with the same tools, substituting a chuck to suit the length of the case being trimmed. The rate of production for this operation is approximately the same as

*Previous installment appeared on page 21. Copyright, 1916, Hill Publishing Co.

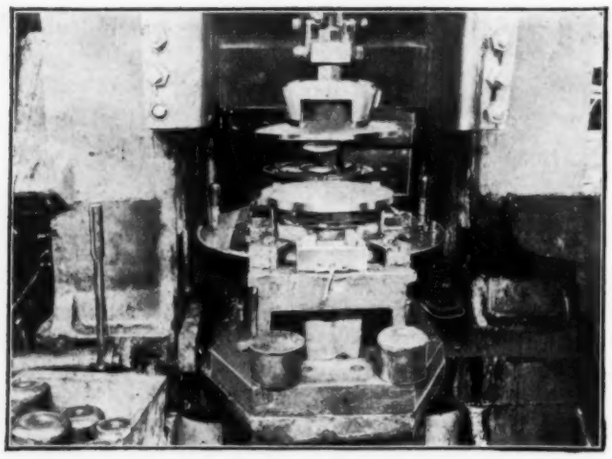
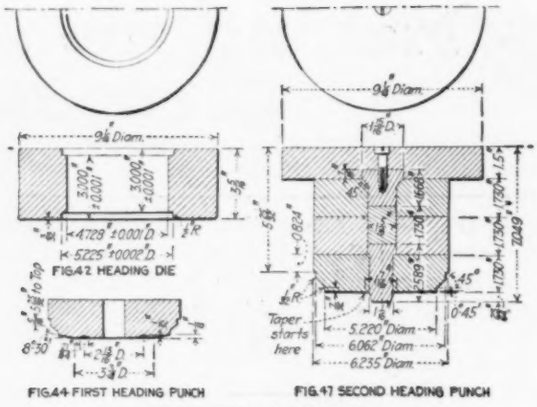


FIG. 40. POWER HEADING PRESS



HEADING PUNCHES

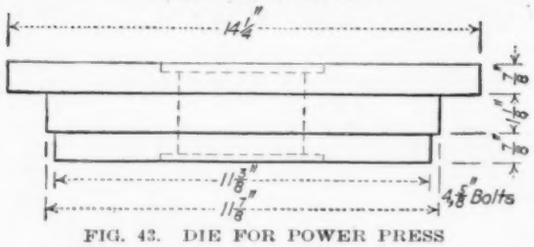


FIG. 43. DIE FOR POWER PRESS

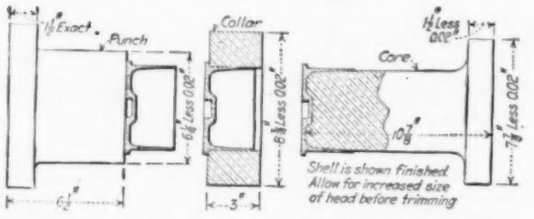


FIG. 45. KNOCK-OUT FOR HYDRAULIC PRESS

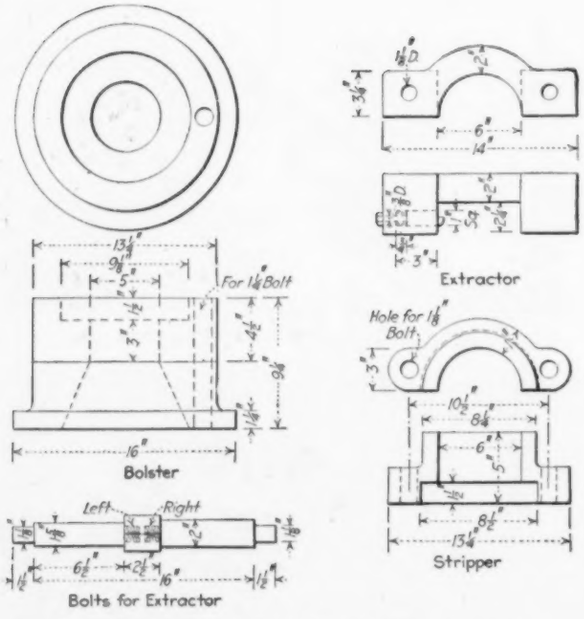


FIG. 41. DETAILS FOR HYDRAULIC PRESS

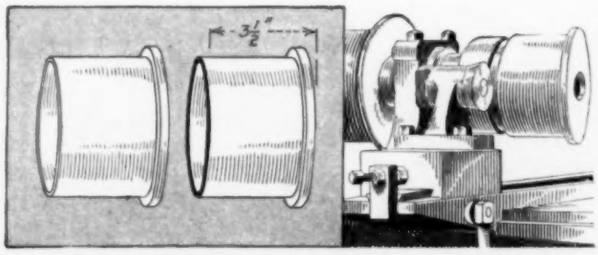


FIG. 49. OPERATION 21: FINAL TRIMMING

Machine Used—Special high-speed lathe with chuck and trimming attachment.
Production—270 per hr.
References—Figs. 28, 29 and 30.

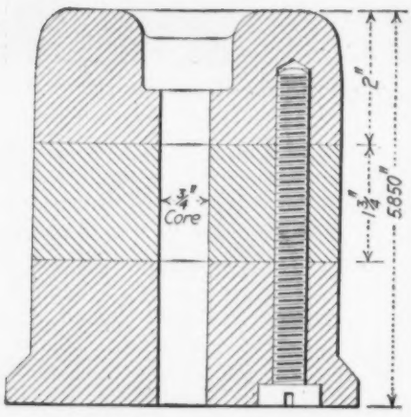


FIG. 46. KNOCK-OUT FOR POWER PRESS

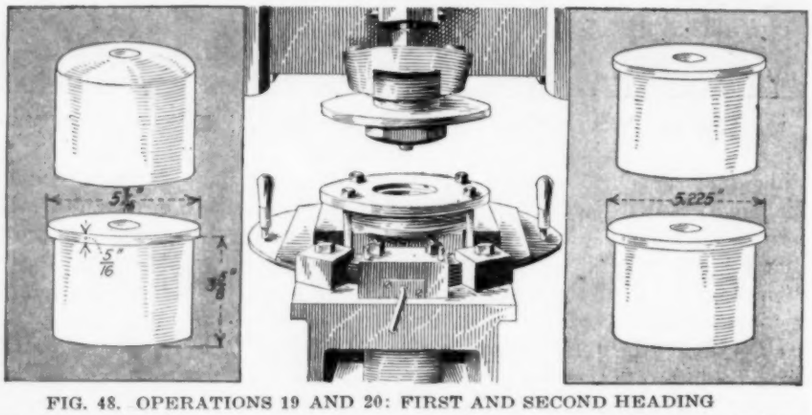


FIG. 48. OPERATIONS 19 AND 20: FIRST AND SECOND HEADING

Machines Used—Waterbury Farrell foundry (hydraulic) 6-in. stroke press; Toledo 2½-in. stroke press.
Production—260 per hr.
References—Figs. 39, 40, 41, 42, 43, 44, 45 and 46 for first heading; Figs. 39, 40, 41, 42, 43, 45, 46 and 47 for second heading.

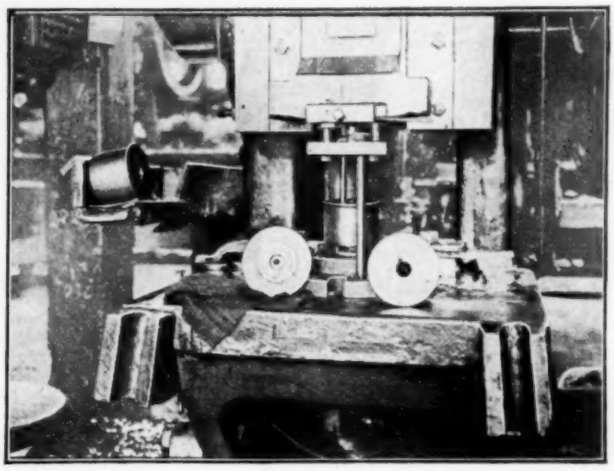


FIG. 50. PIERCING THE CASE

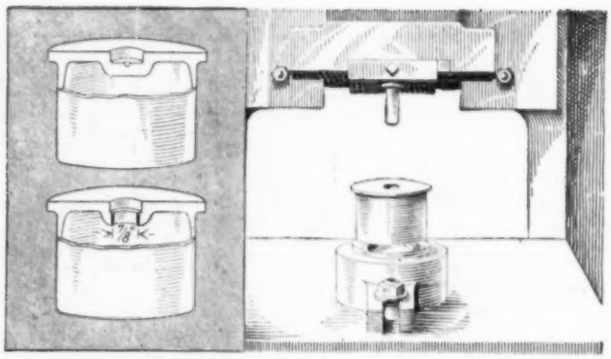


FIG. 52. OPERATION 22: PIERCING

Machine Used—Toledo 5-in. stroke press.
Production—500 per hr.
Pressure—5 tons.
References—Figs. 50 and 51.

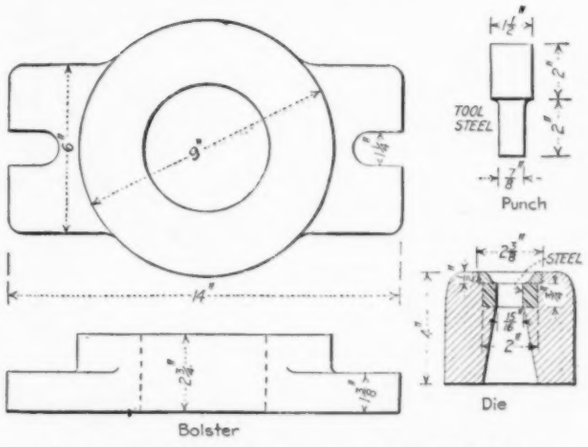


FIG. 51. TOOLS FOR PIERCING OPERATION

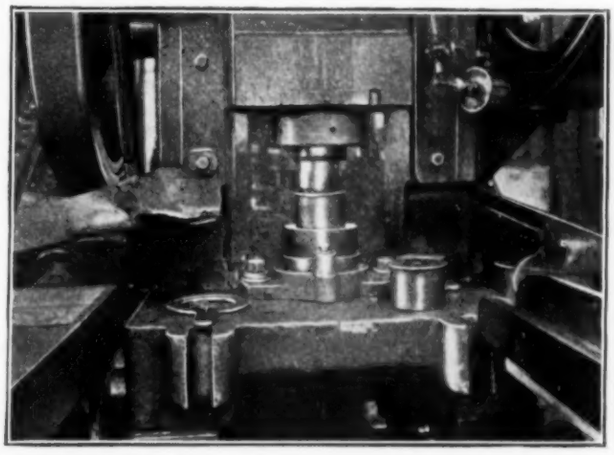


FIG. 53. TAPERING THE CASE

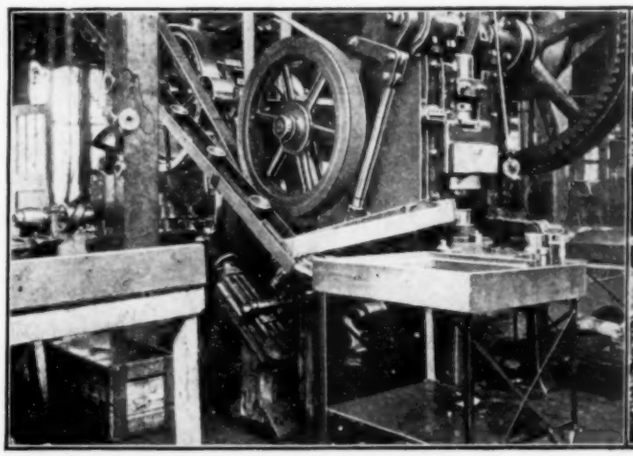


FIG. 58. CONVEYOR FOR CASES

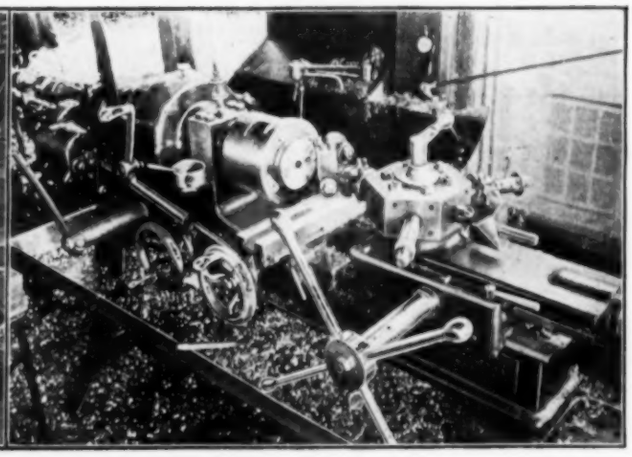
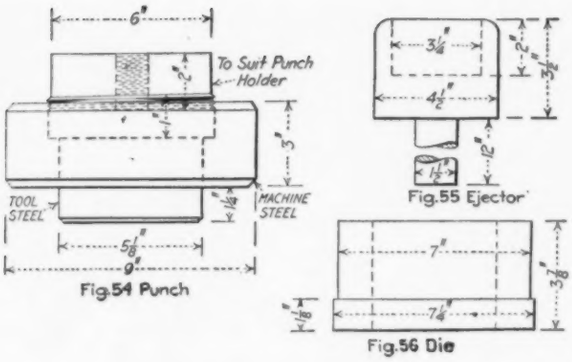


FIG. 59. MACHINING THE CASE

for operation 17. This operation is shown in diagrammatical form in Fig. 49.

The next operation is piercing for the primer hole. The punch press for this operation is illustrated in Fig. 50. The punch, die and bolster for the piercing operation are shown in Fig. 51, and the operation is illustrated in diagrammatical form in Fig. 52. The cases are then ready for the tapering operation. The machine used on this work is seen in Fig. 53. The punch, Fig. 54, ejector, Fig. 55, die, Fig. 56, and bolster, Fig. 17, are employed for the tapering operation, which is also given in diagrammatical form in Fig. 57.

Fig. 58 shows the method of transferring the cases from the trimming machine to the piercing and, finally, the tapering presses. A wooden trough is used, as may be observed at the right of the illustration. The case, after it has been tapered with the machine seen in the foreground, is slid down the chute shown, whence it drops on the chain conveyor. Protruding plates carry along the cartridge cases to the upper floor, where the



TOOLS FOR TAPERING

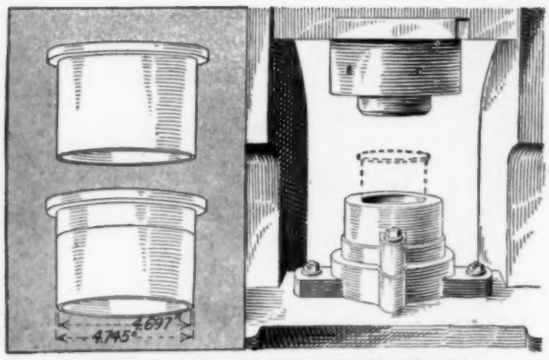


FIG. 57. OPERATION 23: TAPERING

Machine Used—Bliss 6-in. stroke press.
Production—400 per hr.
References—Figs. 17, 53, 54, 55 and 56.

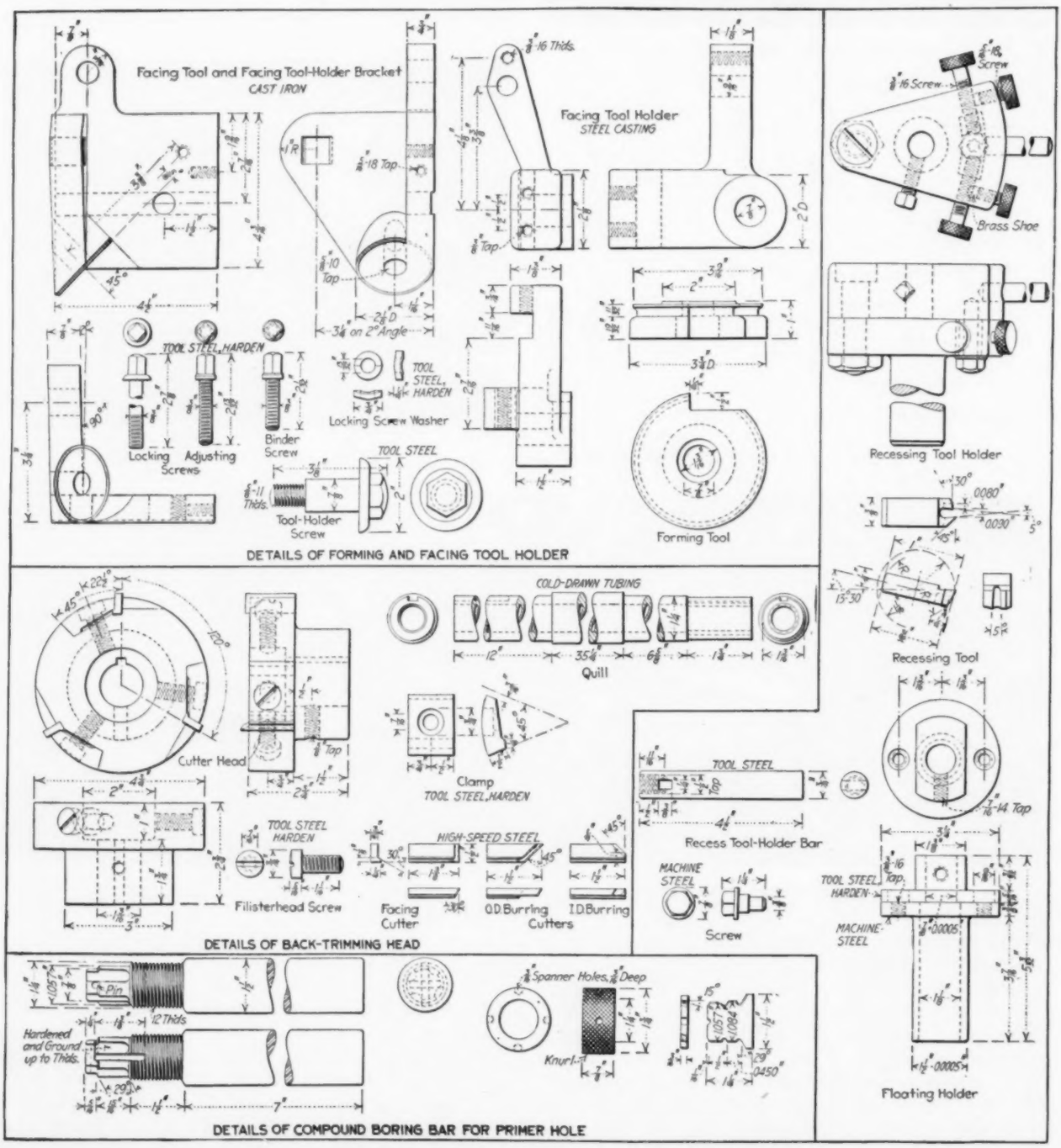


FIG. 60. DETAILS OF TOOLS USED WHEN MACHINING CASE

subsequent operations are performed. The cartridge cases are then given a shop inspection. The gages will be illustrated in detail in a later portion of the article.

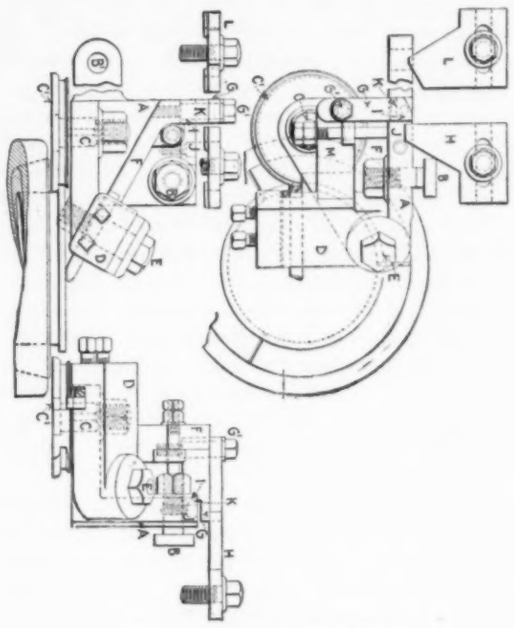


FIG. 60. SET UP OF TOOLS

headed to slide down the chute shown when it drops onto the conveyor. One of the plates which is inserted in the chain of the traveling conveyor coming against the case raises it to the floor above when the machining operations on the head of the cartridge case are performed.

As the case reaches the upper floor it falls into another chute down which it slides to the lathes performing the machining operations. It will be seen by reference to the layout of the tools used in the turret that the face of the case is first machined, the primer hole is next bored, the recess in them formed at the rear of the primer hole. The tapping of the hole is next done and last the facing and counterboring operation. During the facing of the head the flange is machining to the correct contour and

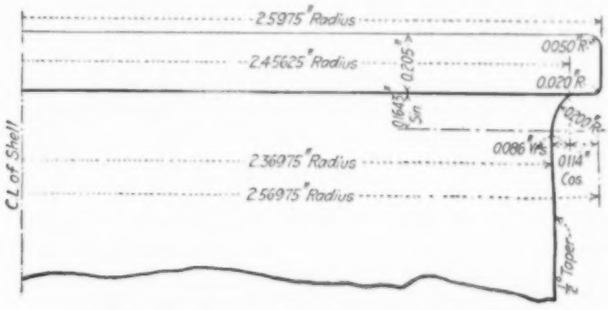


FIG. 63. DETAIL OF HEAD OF CASE

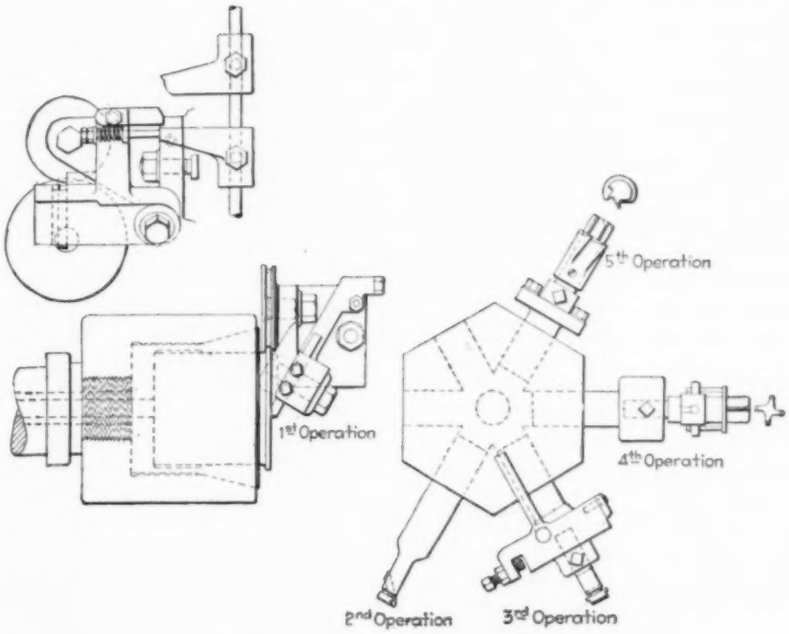


FIG. 61. LAYOUT OF TURRET TOOLS

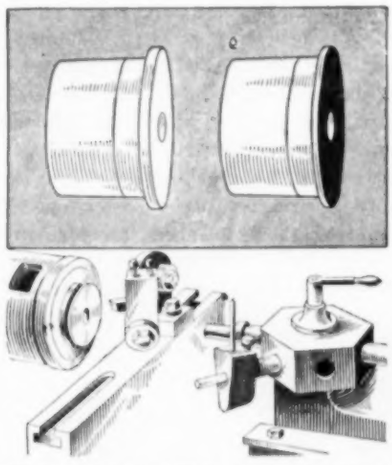


FIG. 62. OPERATION 25: FACE, SQUARE TO LENGTH, ROUGH-THREAD AND COUNTERBORE FOR PRIMER

Machine Used—Warner & Swasey turret lathe.
Production—70 per hr.
Lubricant—All surfaces machined dry except threading, on which lard oil is used.
References—Figs. 59, 60 and 61.

The next operation is facing, squaring to length, rough-threading and counterboring for the primer. The machine for this operation may be seen in Fig. 59. Details of the tools are given in Figs. 60 and 61. The operation is also shown in diagrammatical form in Fig. 62. A detail of the shape required on the head is presented in Fig. 63.

Attention should be called to the interesting method shown in Fig. 58 of conveying the cases from the tapering press to the upper floor where the machining operations are performed. By this means much handling is avoided as the operator merely allows the case after it has been

thickness with a circular forming tool carried at the rear in the cross-slide.

Between other machines are placed wooden chutes so that the cases may be slid between each operation when manufacturing the cartridge case.

This system of transferring work during the various operations to the several machines is well worth adopting both on press operations as here described and also on other machining work. The cartridge case is then ready for the operations that follow after machining the primer hole.

(To be continued)

Purchase and Inspection of Leather Belting

SPECIAL CORRESPONDENCE

The numerous forms of belting on the market may be divided roughly into three groups—first-quality oak-tanned leather, second-grade oak-tanned leather and novelties. In the latter group are fabrics, special tannages of leather and various combinations of these with one another and with oak-tanned leather. In price the range is from a fraction of the price of first-quality leather to about three times its cost. Each is particularly adapted to a certain narrow field of application, but is apt to be recommended by its maker for all purposes. As a whole, belts in this class show a high ultimate cost, since the cheap ones give poor service and the expensive ones do not last long enough to justify their high initial cost. Such belts should be used only where they have demonstrated their superiority in competition with oak-tanned leather.

Cheap grades of leather may be made to look as well as that of highest quality, and the temptation is strong to save the difference in first cost. Purchasers should remember, however, that belting of this kind is either poorly made or consists of stock rejected in the making of the first-grade belting. By the time it has been discarded the belt will have proved very expensive. The legitimate field for belting in this class is on agricultural machinery and similar service, where the conditions are such that no belt, however good, will last long.

First-quality oak-tanned leather belting, represented by the best brands of the leading manufacturers, shows the lowest cost per belt per year, provided it is properly installed and well cared for. For 30 per cent. more than the price of the cheaper grades the best that the market affords may be obtained, and it is obvious that not much gain is required from lessened upkeep, decreased idle machine time or longer life to make the extra investment a profitable one. Ample evidence is available to justify the use of the best oak leather for general machine-shop and similar service.

WHERE TO BUY BELTING

In belting, as in all other forms of leather goods, substitution and deception are easy. No matter how carefully specifications are drawn or inspection enforced, it is important to deal only with responsible and reliable houses. The volume and variety of their output should also be considered, since these factors give the ability to supply any requirements promptly and satisfactorily. For this reason and others it is better to deal direct with the manufacturer rather than through a jobber. A much discussed question is whether it is best to deal with a manufacturer who also tans his leather or with one who buys his raw material in the open market. There is much to be said on both sides, but it should be borne in mind that the ownership of a tannery is not *prima facie* evidence of ability to deliver a better belt. No tannery can produce uniformly good leather.

Large users would do well to divide their orders between two sources of supply as a protection against the failure of one to make deliveries and to get the benefit of healthful rivalry. Location is also an important feature. Better results will be obtained when either the factory or a branch warehouse is near-by, not only for quick service when necessary, but especially because it means accessibility to, and better coöperation with, responsible representatives of the manufacturer.

Having chosen one or two sources of supply and found them satisfactory, every endeavor should be made to avoid frequent changes. Once a manufacturer has become accustomed to the particular needs of his customer, it is greatly to the advantage of both parties to retain the connection. Coöperation is essential to best results.

When belting is being bought or contracted for, it is always well to keep in mind that it may not prove satisfactory. This suggests at once that the kind of material desired should be specified definitely in writing and provision made for its rejection, if defective. On page 683, Vol. 44, a detailed discussion of this subject was presented. Small consumers should order by brand from a reliable house, trusting to its fairness to make good any shortcomings in its product. Large buyers have an opportunity to specify more definitely what they require to meet their special needs and to safeguard themselves against the acceptance of poor material.

Specifications having been determined upon, bids should be invited from five or six of the leading manufacturers for the ensuing six months or a year. The leather market is always a very uncertain factor, especially at this time, and most manufacturers do not look with favor on long-time contracts. Six months is probably a fair period to all concerned.

There are decided advantages in keeping a good stock on hand. Rush orders are thereby obviated, ample time for inspection is available, and most important of all, the manufacturer is able to accumulate from stock in progress the kind best suited to the needs of the customer. The value of such selection cannot be over-estimated.

IMPORTANCE OF CAREFUL INSPECTION

It is a long road from the cattle range to the pulleys of the manufacturing plant, and many operations are necessary to transform a steer hide into a leather belt. At almost every one of these stages the value of the product to the consumer can be influenced for better or for worse. The skill and knowledge of the workman, the condition of his equipment and the kind of supervision under which he works—all combine at each operation to determine whether the belt shall finally be a powerful aid to successful factory operation or the source of endless trouble. Unfortunately, the conditions under which his product is sold and consumed do not give the belt manufacturer much incentive to keep all his processes at high efficiency. Most of his product goes to jobbers and supply houses, from which it is passed on in small quantities to the consumer, generally with price as the incentive rather than quality. Under these conditions a good appearance is often considered more important than invisible quality. This situation leads to practices akin to the coloring of butter, bleaching of flour and polishing of rice, largely practiced by manufacturers of foodstuffs. Only by constant and vigilant inspection can such practices be eliminated and defective material or workmanship discovered. The mere fact that delinquencies are promptly detected and reported to the manufacturer is sufficient to minimize their occurrence.

Where purchases are being made from more than one source, detailed inspection will soon point out their relative merits and the causes. It has the further advantage,

also, that defects discovered before installation save the time and money involved in repairs, replacement and loss of production. A large user can well afford to assign a high-grade man to this duty, preferably one who is in close touch with operating conditions throughout the factory.

Preliminary Examination of Belting

Two inspection tables with rotating tops should be provided and set a convenient distance apart in a good light. When a shipment is received, each roll should be placed on one table and wound onto the other. The entire length of the roll is thus exposed for inspection, and the rewound roll is left ready for storage or use. While the belt is passing before the inspector, he can readily check up the length, width, uniformity of thickness, shimming, excessive evening and other external characteristics. The most important points to watch are:

Injurious Blemishes—All surface markings should be opened up, if possible, by bending the belt, grain side out. Any defect that extends through the outer layer, or "grain," weakens the belt, is apt to become larger in service and readily admits to the interior of the fiber injurious substances such as lubricating oil, dust and metallic particles. On the other hand, surface markings that do not open up on bending cannot be regarded as objectionable. Blemishes likely to cause belt failures can be avoided by careful selection and should not be present in first-quality belting.

Piping—Single belts should be bent through 180 deg. over a ½-in. diameter rod, grain side in, and double belts over a 1-in. rod. Since the inner surface is strongly compressed by this treatment, a wrinkling will be developed. If this is deep enough to extend to the fibrous body under the grain layer, it is known as "piping" and indicates that the leather has been cut from an undesirable part of the hide. Such material will give unsatisfactory service and should not be present in the best belting.

Cracking—When treated in the manner described under piping, but grain side out, no cracking should be developed. This would indicate poorly tanned leather or the shirking of some process that should during manufacture have made the fibers soft and pliable.

Length of Sections—The overall length of the individual sections of which the belt is composed should not exceed 54 in., nor should many of them be less than 42 in. Longer lengths have been cut into the shoulder area, the least desirable part of the hide for belting, while shorter sections, even if of good material, introduce too many cemented joints, each of which is a potential trouble maker in service.

Another point to be watched is uniformity of character, especially as to pliability. Color, however, has no significance if the material is otherwise satisfactory. The manufacturer's name, brand and date should be plainly stamped every 10 ft. as a means of identification in case the service rendered should later prove unsatisfactory.

It is well, also, to unroll a length of about 50 ft. on the floor, noticing whether the belting remains flat at all points without pressure and shows straight laps. A little curvature will be observed, but it should not exceed a foot or two, should be all in the same direction and fairly uniform throughout the entire length. Such belting will run true on the pulleys under a slight tension.

All but the largest consumers can safely conclude their examination at this point, with the assurance that they are getting a very good belt. The process sounds elaborate; but as a matter of fact, when the proper facilities are provided and the inspector has become accustomed to his duties, a speed of 1,000 ft. per hr. can easily be attained. All the foregoing tests need not be applied to each roll, but the most important tests should be applied to every foot of belting purchased.

Physical and Chemical Tests

Purchasers whose investment for belting in service totals hundreds of thousands of dollars can well afford to look a little deeper into the chemical and physical properties of their purchases. Samples should be taken at random from part of each shipment and subjected to the laboratory tests to be described.

Tensile Strength and Elongation—A specimen cut with a die lengthwise of the belt may readily be tested to destruction in any standard testing machine. A length of 12 in. and a width of 1½ in. is very satisfactory. To insure rupture near the center, the specimen should be necked down to a width of 1 in. for a length of at least 2 in. Before the specimen is mounted in the machine, a length of exactly 2 in. should be marked off on the center line in the necked portion. The elongation at rupture or any intermediate point can easily be read off in per cent. with a scale graduated to hundredths of an inch. The ordinary flat clamps commonly used in testing metals are apt to give erroneous results by allowing the specimen to slip more on one side than the other, causing rupture before the full strength of the material has been developed. A better method is to use a fixture consisting of a cylinder held in each head of the machine. The ends of the specimen are passed over the cylinders and clamped on the opposite side. This allows any unevenness of stress to distribute itself before reaching the neck. The speed with which the machine is operated makes a material difference in the results, and a belt or motor drive is preferable. Elongation should be measured at the prescribed tensile strength, since it is obviously unfair to charge an unusually strong specimen with the total elongation at rupture or to credit a weak one with a low value.

Cemented Joints—A similar procedure should be followed in determining the strength of cemented joints, except that elongation need not be observed. The progress of elongation should be noticed, however, and the point where serious distress becomes evident. This should not be less than 90 per cent. of the specified tensile strength. All tensile tests should be recorded in pounds per inch of width, not in pounds per square inch.

Occasional tests should be made to determine the percentage of greases introduced during manufacture to promote pliability and to protect the belt from absorption of foreign matter such as lubricating oil, water, fumes, etc. This examination should be made in accordance with the standard practice of the American Association of Leather Chemists.

The presence of mineral oils, inorganic acids or anything detrimental to the strength, pliability or durability of the leather should be detected by suitable tests. Likewise, loading for artificial weight by means of white lead or other foreign matter can be detected by burning a sample and weighing the ash.

Reliable manufacturers are always willing to stand behind their goods in service. Poor material or workmanship will occasionally evade the most vigilant inspection—hence, the importance of the branding previously mentioned. The most frequently occurring defects after installation are excessive stretching, uneven stretching, cracking and poor joints. For any of these defects a good maker will cheerfully make adjustment if notified promptly, provided the belt has been properly installed and not abused. Before making claims, however, it is wise to make certain that these conditions have been fulfilled. Few failures will be found if the pulleys are in line, parallel and large enough for the kind of belt used; if the belt is not allowed to rub against bearings, hangers, posts or shifters; if lubricating oil and other destructive agents are kept away; if proper tension is maintained and if the belt is not overloaded.

Really first-class belting, properly applied and cared for, will give splendid service and a surprisingly long life.

Special Operations in a Textile Machine Shop

EDITORIAL CORRESPONDENCE

For manufacturing hosiery machines Scott & Williams, Inc., Laconia, N. H., employ some interesting tools and methods. In Fig. 1 is illustrated the fixture used in drilling pattern drums. The casting *A* is located by the shaft *B*, which is supported in a bracket at each end, as shown. The locating of the various holes is obtained with the index drum *C*. As the pointer *D* is dropped into the indexing hole of the drum *C*, the casting *A* is in the correct position for drilling. In this pattern drum, 158 No. 37 holes are drilled. The time required is 15 min.

The way in which the flutes are milled in the rolls may be seen in Fig. 2. After the roll has been turned to the correct diameter, it is placed between centers in the lathe and driven by a dog at the head end. The knurl holder is fitted with three knurls, and the shank is attached in the tool post, as shown. With the shaft revolving, the knurl holder is caused to travel along the shaft, and a good form of knurl is produced. One of the holders is illustrated at *A*, and the design may be easily observed.

In Fig. 3 is shown the attachment used in milling the segment gears. The casting is located on a stud and held in position with a nut and washer. It is located by stops at *A* and *B*. The gang cutters consist of two 3x¾-in. and one 2x⅝-in. between them. Motion to revolve the casting and fixture is obtained through the worm and wormwheel *C*, spiral gears *D* and wormwheels *E*. The driving wormwheel of the pair of gears *E* is attached and driven by the

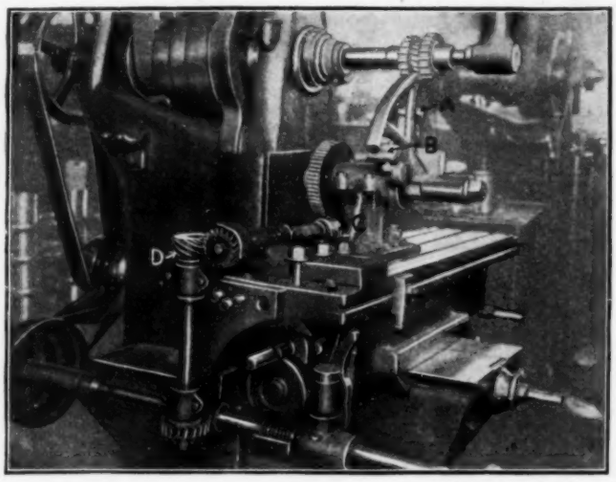


FIG. 3. ATTACHMENT FOR MACHINING A SEGMENT GEAR ON THE MILLER

driving belt of the miller, as shown at the left of the illustration. This method of machining the circular surface on the gear is proving successful, and the surface produced is all that could be desired.

These three special methods are being used with great success in the manufacture of hosiery machine parts and as will be noted good results so far as time is concerned are obtained. When drilling other pattern drums than that shown in the illustration, a different indexing cylinder is placed on the arbor of jig, Fig. 1; thus this jig may be applied for a variety of different designs of pattern drums which are machined in the manner shown. The method shown of milling the segment gear is also interesting as it will be observed that the cutters are machining surface at all times, which would not be possible if the part was rotated on an arbor and the surface machined in a lathe, without some oscillating device being used. A good surface is also produced.

The method used when milling the flutes on the rods is interesting. The tool is held in the tool post and fed along the rotating bar. Three knurls are held in contact with the rod by means of a clamp bolt at the rear.

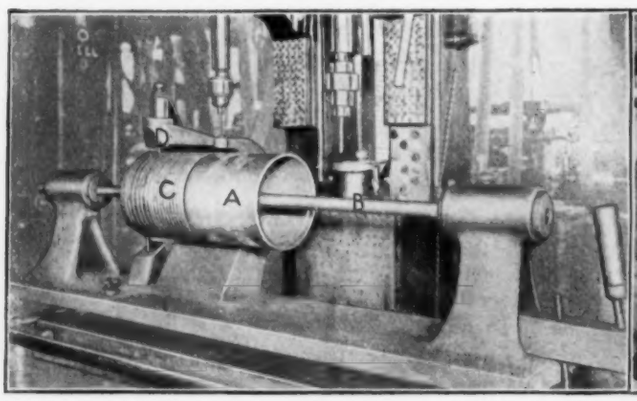


FIG. 1. DRILLING PATTERN DRUM WITH A SPECIAL INDEXING FIXTURE

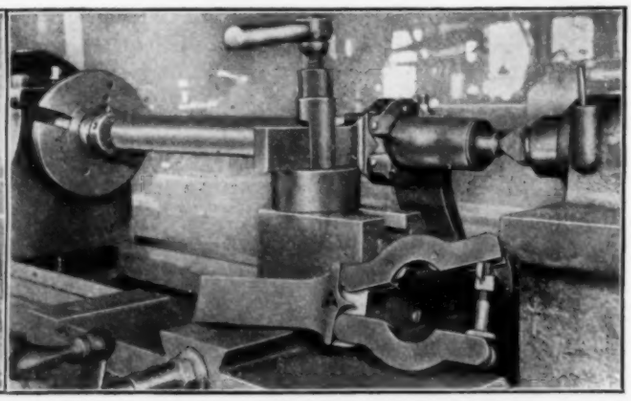


FIG. 2. MILLING FLUTES ON ROLLS IN THE LATHE WITH A THREE-KNURL TOOL

Letters from Practical Men

Combined Table of Drill Sizes of A. S. M. E. Screws

In order to save time and trouble in referring back and forth to tables to find either a tap or a body drill size for a certain size of screw I have compiled the accompanying table, together with the drill sizes for flat and fillister-head screws. These are American Society of Mechanical Engineers standards.

We do not always realize the time lost in referring from one table to another. By combining tables in this way we can also eliminate one chance of error that creeps in whenever we copy a value or try to remember it, as we turn to look it up in another place.

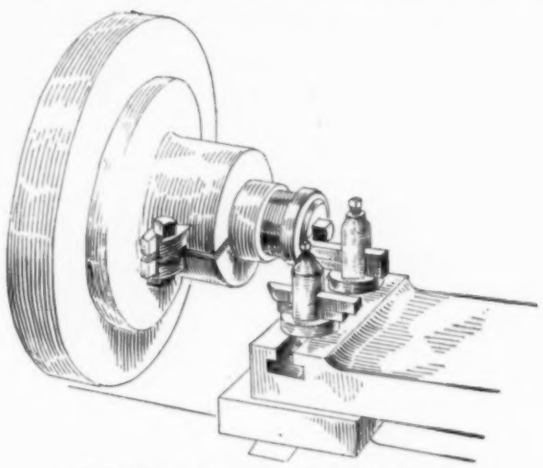
I believe a good many of your readers will appreciate a table of this kind and find it a great convenience, as I have.

A. ELTING.

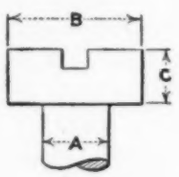
New York City.

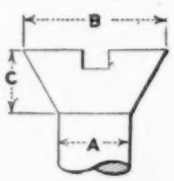
Trimming Off the Base Plugs of Shells

The sketch herewith shows the equipment used by the writer for cutting of the square tit and facing off the surplus metal of the base plug after it has been riveted into the shell. It is easily applied to the lathe.



TRIMMING BASE PLUGS OF SHELLS





DRILL SIZES FOR A. S. M. E. MACHINE SCREWS

No. of Screw	No. of Threads	Diameter of Screw "A"	No. of Tap Drill or Letter	Tap-Drill Diameter	No. or Letter of Body Drill	Body-Drill Diameter	B	C	No. or Letter of Drill	Diameter of Drill	B	C	No. or Letter of Drill	Diameter of Drill
0	80	0.060	56	0.0465	52	0.0635	0.0894	0.0376	43	0.089	0.112	0.029	33	0.113
1	72	0.073	53	0.0595	49	0.073	0.1107	0.0461	34	0.111	0.138	0.037	28	0.1405
*1	64	0.073	54	0.055	49	0.073	0.1107	0.0461	34	0.111	0.138	0.037	28	0.1405
2	64	0.086	50	0.070	44	0.086	0.132	0.0548	29	0.136	0.164	0.045	19	0.166
*2	56	0.086	51	0.067	44	0.086	0.132	0.0548	29	0.136	0.164	0.045	19	0.166
3	56	0.099	46	0.081	39	0.0995	0.153	0.0633	23	0.154	0.190	0.052	11	0.191
*3	48	0.099	47	0.0785	39	0.0995	0.153	0.0633	23	0.154	0.190	0.052	11	0.191
4	48	0.112	43	0.089	33	0.113	0.1747	0.0719	16	0.177	0.216	0.060	2	0.221
*4	40	0.112	44	0.086	33	0.113	0.1747	0.0719	16	0.177	0.216	0.060	2	0.221
*4	36	0.112	45	0.082	33	0.113	0.1747	0.0719	16	0.177	0.216	0.060	2	0.221
5	44	0.125	38	0.1015	30	0.1285	0.196	0.0805	9	0.196	0.242	0.067	C	0.242
*5	40	0.125	39	0.0995	30	0.1285	0.196	0.0805	9	0.196	0.242	0.067	C	0.242
*5	36	0.125	40	0.098	30	0.1285	0.196	0.0805	9	0.196	0.242	0.067	C	0.242
6	40	0.138	33	0.113	28	0.1405	0.217	0.089	2	0.221	0.262	0.075	H	0.266
*6	36	0.138	34	0.111	28	0.1405	0.217	0.089	2	0.221	0.262	0.075	H	0.266
*6	32	0.138	36	0.1065	28	0.1405	0.217	0.089	2	0.221	0.262	0.075	H	0.266
7	36	0.151	31	0.120	24	0.152	0.2386	0.0976	B	0.238	0.294	0.082	M	0.295
*7	32	0.151	31	0.120	24	0.152	0.2386	0.0976	B	0.238	0.294	0.082	M	0.295
*7	30	0.151	32	0.116	24	0.152	0.2386	0.0976	B	0.238	0.294	0.082	M	0.295
8	36	0.164	29	0.136	19	0.166	0.2599	0.1062	G	0.261	0.320	0.090	P	0.323
*8	32	0.164	30	0.1285	19	0.166	0.2599	0.1062	G	0.261	0.320	0.090	P	0.323
*8	30	0.164	30	0.1285	19	0.166	0.2599	0.1062	G	0.261	0.320	0.090	P	0.323
9	32	0.177	26	0.147	16	0.177	0.2813	0.1148	K	0.281	0.346	0.097	S	0.348
*9	30	0.177	27	0.144	16	0.177	0.2813	0.1148	K	0.281	0.346	0.097	S	0.348
*9	24	0.177	29	0.136	16	0.177	0.2813	0.1148	K	0.281	0.346	0.097	S	0.348
10	30	0.190	22	0.157	11	0.191	0.3026	0.1234	N	0.302	0.372	0.105	V	0.372
*10	32	0.190	21	0.159	11	0.191	0.3026	0.1234	N	0.302	0.372	0.105	V	0.372
*10	24	0.190	26	0.147	11	0.191	0.3026	0.1234	N	0.302	0.372	0.105	V	0.372
12	28	0.216	15	0.180	2	0.221	0.3452	0.1405	S	0.348	0.424	0.120	7/16	0.437
*12	24	0.216	17	0.173	2	0.221	0.3452	0.1405	S	0.348	0.424	0.120	7/16	0.437
14	20	0.242	7	0.201	C	0.242	0.3879	0.1577	X	0.397	0.472	0.135	31/64	0.484
*14	20	0.242	11	0.191	C	0.242	0.3879	0.1577	X	0.397	0.472	0.135	31/64	0.484
16	22	0.268	2	0.221	I	0.272	0.4305	0.1748	7/16	0.437	0.528	0.150	17/32	0.531
*16	20	0.268	3	0.213	I	0.272	0.4305	0.1748	7/16	0.437	0.528	0.150	17/32	0.531
18	20	0.294	C	0.242	M	0.295	0.4731	0.1920	31/64	0.484	0.580	0.164	19/32	0.593
*18	18	0.294	B	0.238	M	0.295	0.4731	0.1920	31/64	0.484	0.580	0.164	19/32	0.593
20	20	0.320	H	0.266	P	0.323	0.5158	0.2092	33/64	0.515	0.632	0.179	41/64	0.640
*20	18	0.320	H	0.266	P	0.323	0.5158	0.2092	33/64	0.515	0.632	0.179	41/64	0.640
22	18	0.346	L	0.290	S	0.348	0.5584	0.2263	9/16	0.562	0.682	0.194	11/16	0.687
*22	16	0.346	K	0.281	S	0.348	0.5584	0.2263	9/16	0.562	0.682	0.194	11/16	0.687
24	16	0.372	N	0.302	V	0.377	0.6010	0.2435	37/64	0.609	0.732	0.209	47/64	0.734
*24	18	0.372	O	0.316	V	0.377	0.6010	0.2435	37/64	0.609	0.732	0.209	47/64	0.734
26	16	0.398	Q	0.332	Y	0.404	0.6437	0.2606	41/64	0.656	0.788	0.224	51/64	0.796
*26	14	0.398	P	0.323	Y	0.404	0.6437	0.2606	41/64	0.656	0.788	0.224	51/64	0.796
28	14	0.424	S	0.348	7/16	0.437	0.6863	0.2178	11/16	0.687	0.840	0.239	27/32	0.843
*28	16	0.424	T	0.358	7/16	0.437	0.6863	0.2178	11/16	0.687	0.840	0.239	27/32	0.843
30	14	0.450	V	0.377	29/64	0.453	0.7270	0.2950	47/64	0.734	0.892	0.254	29/32	0.906
*30	16	0.450	W	0.386	29/64	0.453	0.7270	0.2950	47/64	0.734	0.892	0.254	29/32	0.906

*Special sizes of A. S. M. E. machine screws.

The machine is a plain 20-in. American engine lathe that is nearly old enough to vote. It is fitted with a home-made split chuck and an extra tool holder. One tool holder takes a parting tool for cutting off the square end, and the other tool holder carries an ordinary round-nose tool for squaring up the base of the shell and plug. The shell forgings are about 50 carbon, but much harder to cut than the carbon content would lead one to expect.

With this equipment we can do 168 British 4.5-in. shells every 10 hr., the lathe running at 130 r.p.m. Tool feed is by hand for parting and $^1/_{48}$-in. feed per revolution for facing.

JOHN S. WATTS.

New Glasgow, Nova Scotia.

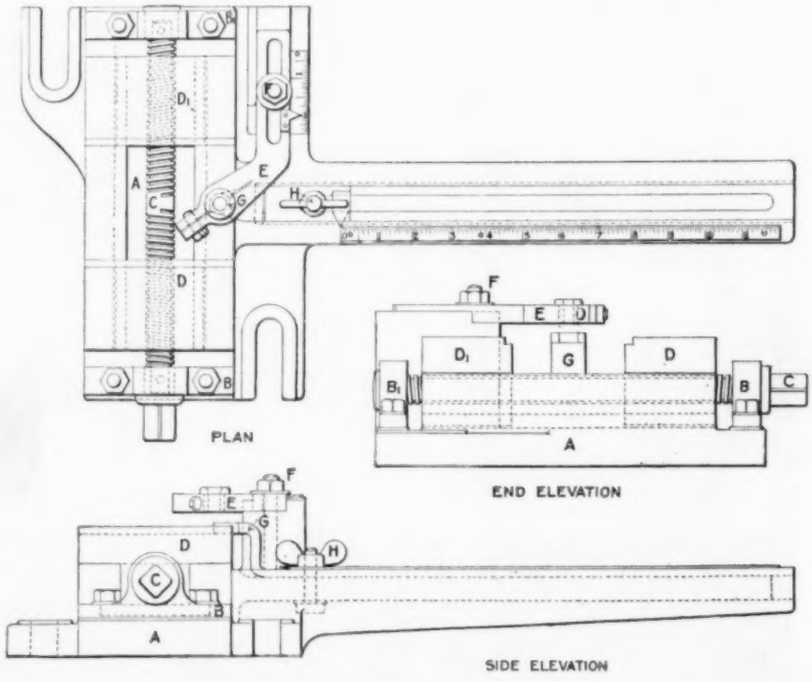
Adjustable Drill Jig

Many a man has been troubled time and again by the loss involved in the laying out of holes in instances where a job consisted of "just not enough" pieces to make profitable a special drill jig. In fact, the laying out of holes often amounts to the same as the drilling itself, which depends of course greatly on the pay of the man who scribes off and of the boy who runs the drill press.

To eliminate the expense of scribing, the use of a double-gage drill jig, as shown in the accompanying illustration, not only proves to be a paying investment, but pleases the men, and there is no wear to it.

The bedplate *A* is provided with two lugs to clamp it to the table of the drill press. Bearings *B* and *BI* on the ends of the bedplate carry a right- and left-handed screw *C*. By means of this screw the vise jaws *D* and *DI* can be moved. They always remain equally distant from the center of the jig and automatically center any piece gripped between them, as can be easily understood. The jaws of the vise run in T-slots in the bedplate. Between and above the jaws a drill bushing is fastened in a holder *E*, which is split at the end so that the proper bushing can be inserted. The holder is slotted at the other end, which enables it to move parallel to the right- and left-hand screw. It runs in the recess in a projection on the bedplate. Pointer and gage indicate directly how much the bushing is off center. When in the right place, the holder is firmly clamped down by the screw *F*.

In the center of the jig, the stop *G* can move at right angles to the right- and left-hand screw. The pointer and the gage on the tail of the bedplate indicate the distance between the end of the stop and the center of the bushing. The stop is fastened by a wing nut and screw *H* in a machined slot.



ADJUSTABLE DRILL JIG

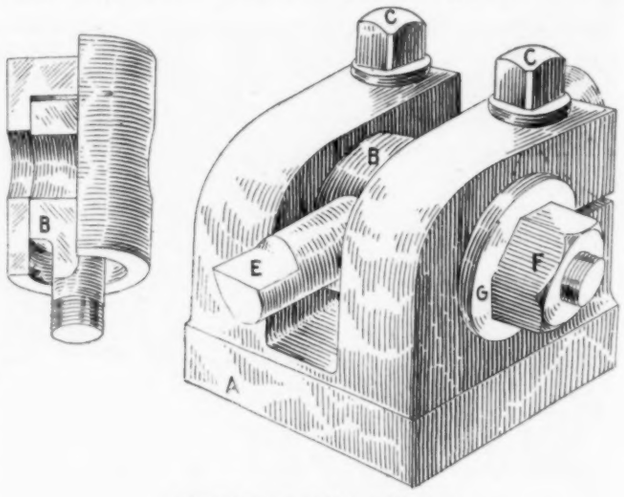
As only one hole at a time can be drilled in each piece, the jig requires some extra handling of material, but this is fairly well balanced by the consideration that an ordinary jig has to be moved for each hole.

In case the jig is subject to heavy use, the wearing surfaces of the vise and the stop have to be hardened.

Brooklyn, N. Y. JAN SPAANDER.

Round-Bar Tool Holder

Herewith is shown a rugged tool holder for tools of the round-bar type. This holder may be used almost anywhere, as on a lathe turret, a carriage, etc. It consists of a heavy base *A*, either a good casting or forging, in which the tool block *B* is free to rotate when released by the clamping screw *C*. These screws serve to clamp the two binder bushings together, thus locking the tool block in any position. The tool *E* is locked in the block by means of the nut *F*, which tightens against the washer *G*.



ROUND-BAR TOOL HOLDER

W. BURR BENNETT.

Bridgeport, Conn.

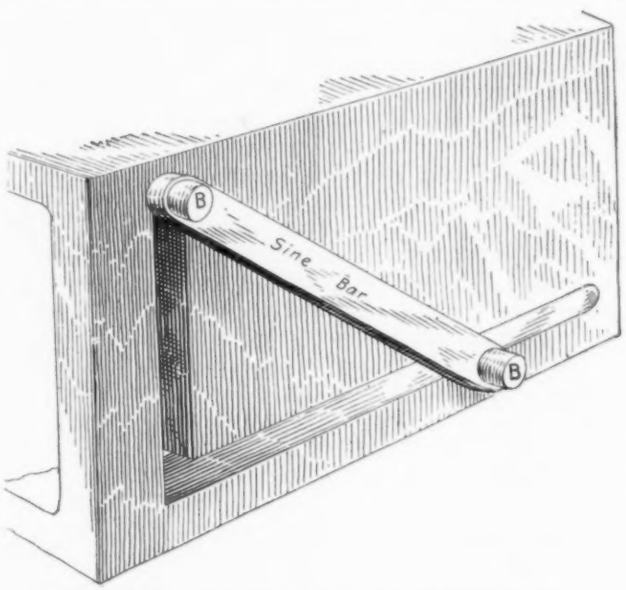
Exports of Ingots, Billets and Blooms, according to figures compiled by the Bureau of Statistics have grown at such a rate that 1,000,000 tons per year have been reached. With an increase from 50,942 tons per month in the last quarter of 1915 to 84,770 tons per month for the first four months of 1916, the outgo has reached the record rate of 1,017,240 tons per year.

Discussion of Previous Question

Improved Type of Sine Bar

The sine bar is undoubtedly a most useful tool. Its usefulness is so well known among tool makers that it has received probably more than its share of space in past numbers of the *American Machinist*. On page 820, Vol. 44, the subject was again raised by Wesley E. McArdell in an article discussing the merits of an "improved type of sine bar."

A somewhat extended experience with angular work has convinced me that the sine bar without some ready means of support is a most efficient time waster. Before it can be used, it must be clamped to an angle plate. Then it must be tapped to the correct setting. Quite possibly, before the correct setting is obtained the clamps



SINE BAR HOLDING AND SETTING FIXTURE

must be moved. Further, during the progress of the work the setting of the bar must be tested. Since it is held only by clamps, there is a possibility of its moving. All this is well known to its users, and the improved type suggested by Mr. McArdell does nothing to provide a remedy.

A device designed by the writer to save time in setting the sine bar makes the setting positive for any angle desired. This contrivance is shown in the illustration. It is merely a special form of box angle plate having a right-angle slot parallel to two of its sides. The buttons *B* pass through the sine bar and are, on their reduced diameter, a good fit in the slot. A nut and washer on each button secure the sine bar at the necessary inclination.

To simplify the calculations, the center of the slot should be a definite distance from the edge of the box. It saves time to engrave this distance on the face of the plate. In setting the bar with the height gage, if the center of the slot is 1½ in. from the edge and the diameter of the buttons 1 in., then 2 in. is added to the calculated height when gaging from the top of the button.

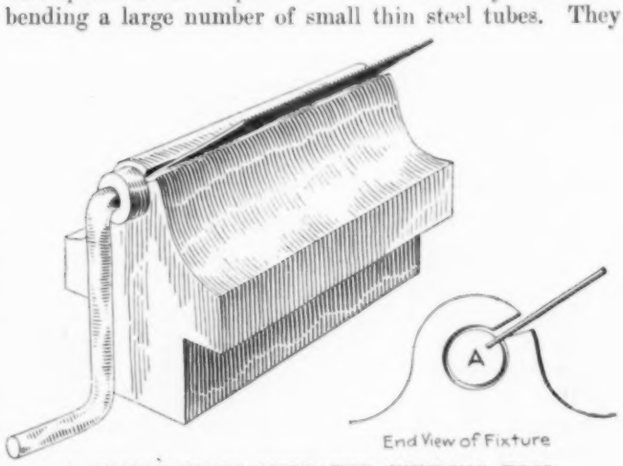
The great advantage of this fixture comes in when we have an angle that may be repeated. It is also valuable in those cases, and they are many, where we have to do work on the bar and require a positive support. In such instances a slip gage of the necessary length, made from, say, ½ square material, is put into the vertical slot. The button pins resting on this gage give the desired angle in minimum time, and work can be performed on the sine bar without any danger of moving. It is convenient to mark the slip gages in angles as well as lengths.

For use with a 10-in. sine bar having buttons 1 in. in diameter, the stems of which are of ¾-in. diameter, the slots in the box should be about 11 in. and 8 in. long respectively. Then for angles up to 45 deg. the short slot is vertical. For the larger angles the long slot is in the vertical position. Both sine bar and buttons should be hardened and ground. A series of tapped holes in the box angle will assist in securing work in position on the bar, if necessary.

Surrey, England. WALTER G. GROOCOCK.

A Simple Hand-Operated Bending Tool

After reading the article about a hand-operated bending fixture, page 513, Vol. 44, I am prompted to write a description of a simple tool that I recently made for bending a large number of small thin steel tubes. They



A SIMPLE HAND-OPERATED BENDING TOOL

were required for the short pieces of black-lead pencils and were termed "pencil economizers." These tubes were made of No. 32 B. G. (0.0098-in.) planished steel, the material having a highly finished blue surface. In making the tubes pieces of the metal were cut $\frac{1}{16}$x4½ in., which gave the required dimensions—$^{19}/_{64}$ in. in diameter by 4½ in. in length.

In the illustration is shown the bending appliance. It is used in a bench vise and is made of cast iron, with the exception of the roller and handle, which consist of a piece of $^{9}/_{32}$-in. diameter steel rod bent to the shape shown. Before turning the handle the edge of the sheet metal is placed in a narrow groove that will be observed in the roller at *A*. To use this bending tool, the piece of sheet metal is pressed evenly with the left hand in the groove in the roller, and the handle is turned with the right hand. The output of tubes by this simple appliance was at the rate of 700 per hr., which was considered satisfactory.

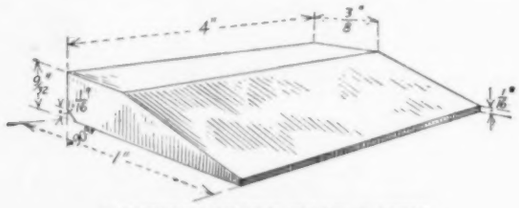
A. EYLES.

Manchester, England.

Design of Holding Jaws

On page 1002, Vol. 44, Robert J. Beuter indicates that any information on the subject of "hold-downs" would be appreciated. For the benefit of those contemplating making a set of these useful tools, I herewith submit a sketch of a pair of "hold-downs" that I made three years ago. They have never failed me, even under the most trying circumstances.

I have held down a 60-point carbon die block for drop-forge dies while taking a ⅛-in. cut in a shaper, with never a fear of my "hold-downs" jumping. For thin



A SATISFACTORY HOLD-DOWN

stock they are almost indispensable. They are made of Ketos steel, hardened and ground parallel on the edges, which contact with the vise jaw and the work. The edges are also ground 90 deg. to the bottom.

All that is necessary to make this kind of "hold-down" work like a charm is to grind on the bottom corner of the wider edge a bevel equaling the width of the narrow edge.

Dayton, Ohio. HUGO F. PUSEP.

Metric System in Export Trade

I have read with interest the editorials in the *American Machinist*, also the contribution of Henry R. Towne, on page 825, of Vol. 44.

The revival, or perhaps we may say, the ever-recurring epidemic of the metric system may be said to be one of the little things sent along to try us and raise our ire.

It is many years since I had the audacity to question the statement of a well-known professor who informed me, among others, that all go-ahead countries were adopting the metric system. I put the question, "What are the most prominent countries, and how many of them use the metric system?" He did not think an answer necessary.

Many firms, British and American, use inches and meters as a business necessity, as Mr. Towne shows. This evidences no particular favor for the metric system. Many of us are in the position of the ambidextrous individual, only with a bias on the right. To sum up the matter, we are politely asked to tie up our right and give the other fellow full freedom to attack us with both hands.

I know of some British firms that have given the metric system an out-and-out trial. All may be described as failures. Messrs. Willans & Robinson, mentioned in your editorial, gave up the system because "their designers thought in inches and then wrote millimeters." The man who designs a crowbar about 5 ft. long and then thinks it out in millimeters does not benefit by the system; he is only wasting time.

Aside from the financial aspect (which means that should we adopt the metric system millions of dollars worth of tools must be scrapped), the question of thought must be considered.

We and our children have been trained to think in inches and yards, some of us even in thousandths of an inch. It is not important whether the rule in our hand be metric or foot, but what we "think with," or what our brains are familiar with, that is the important thing. Are we to throw overboard our brains, "tie up our right," and adopt a system doubtful as to its advantages, though certain to cause endless confusion until a new race trained in our schools to think in these particular units can be produced?

Of course, we all think ourselves quite as good as the other fellow, but at the same time fail to see why we should deliberately handicap ourselves by adopting a Will-you-walk-into-my-parlor policy, and make his foreign trade a home trade and our home trade all foreign.

In conclusion, I remember discussing the metric system some years ago with a canny old Scotch engineer. On my asking what were its advantages, he replied: "Well, ye see it's this way: When ye dee, they usually pit ye awa' in a sax-foot plot, but under this new-fangled system ye get two meters instead. Ye have the advantages of anither sax an' three-quarter inches or thereaboots."

Belfast, Ireland. F. P. TERRY.

Promoting the Right Man

While reading Mr. Stuart's article under the above title on page 1041, Vol. 44, many readers will remark that no man is able to be his own critic, and the Hartfordian writer has not proved to be an exception. The fact that he reads the *American Machinist* and that he is interested enough in the welfare of the trade to write for "our" paper brand him as a man above the average. How many of his former coworkers have read a technical paper? How few of them have ever attempted to write for one? How many stupids spend three nickels a week on Sunday papers to find a better job, while seven and a half cents a week for the *American Machinist* would teach them how to fill it? This is not the only thing that demonstrates that Mr. Stuart is above the average. The special job that gave him his chance could have been done by "any *good* toolmaker." The italics are mine. Whenever a man ceases to admire his work after it is finished, he is on the track to better results.

Mr. Stuart's superintendent was aware of the fact that the man on the special job was above the average, and he singled him out long before he ever had any need for him in another capacity. A "super" has no time to learn all the good and bad points of all his men, and he has to put them down as average till they prove to be otherwise. The few to whom are given the opportunity to prove their superiority are chosen, and no superintendent can be

blamed for picking the man who demonstrated his value. Mr. Stuart's rapid rise from the ranks proves that he was hand-picked and disproves his argument.

A third party will also regard the case of friend Tom from quite a different angle. Tom is described as a man who knew his business; a man ten years the senior of Stuart; a quiet man, a man with fully developed self-respect. The offer to take a foreman's position was welcome enough, but to work under an old friend, young in years and experience, went against the grain. The offer, however, was Tom's first trump card. His employers may have had the old-fashioned idea never to promote a man unless forced by circumstances. In all probability they knew Tom's value thoroughly and friend Stuart's offer put Tom in his right place.

There certainly are foolish promotions. A good man is often passed by because he is valuable at the work he is doing. These cases are rather numerous and such men are in an unfortunate position, as they pay the price of another man's egotism. But the moment they have sized up the stiuation, they are able to command much better remuneration than their coworkers. Several promotions which are regarded by the men as foolish appear otherwise if looked at from the employer's viewpoint. There usually is some method in his madness. The best proof of this was given me last winter, when in charge of a gang on some outside jobs in New England. In rapid succession we met the heads of departments of about a dozen firms. It was impossible for my men to know all their names in the short time they came in contact with them, but they always could tell to which firm any *outstanding* man belonged as long as all the "higher-ups" of a firm showed the same main traits of character. These characteristics were often pronounced and showed that each firm had a decided preference as to the qualities it wanted its men to possess.

At least two-thirds of the American firms have theories about hiring or promoting men, although their executives may not be aware of it. Some of the executives avoid friction in the shop by filling the vacancies higher up with outsiders, and discharging them if they do not come up to standard. This system has many advantages, but in northern continental countries, where this system was formerly practiced, laws have been passed making it impossible to lay a man off without one week's notice for the ordinary mechanic, one month for foremen and often several months for men in more important positions. This was to give a man a chance to keep on the level he had reached.

Hiring and promoting in the old country has to be done with great skill, as hiring a man or promoting a man to the wrong position might entail several months' loss of salary to a firm. Large concerns promote their men and shift them to other departments to escape jealousy; smaller companies suggest to the climber that he get out, gain more experience and then return. Often a man is sent out as a "volunteer" to a friendly firm abroad, his own firm defraying his expenses and "after having finished his education," the erstwhile Jack returns as Mr. So and So. His absence also has possibly broken up chummy relationships.

Such methods have proved to be of great advantage to all parties concerned and recently they have found their way to America. A large utility company that gives the utmost care to the hiring, promotion, education and financial welfare of its employees, has been one of America's greatest successes of the last six years.

Some readers of the *Machinist* will not be able to see the logic of Mr. Stuart's article, still he deserves a lot of credit for having started a discussion that can have only a good influence on those possessing the power to promote efficient workmen.

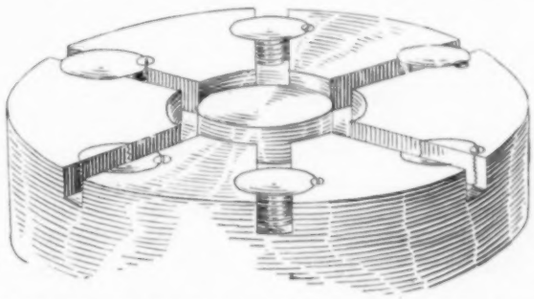
JAN STAANDER.

Brooklyn, N. Y.

Repairing Tool-Holder Slots in a Turret-Lathe Tool Head

The article on repairing tool-holder slots, on page 1002, Vol. 44, reminds me of a repair recently done on a Jones & Lamson turret. The ⅝-in. 11-thread tapped holes in the turret were stripped. The illustration shows the way the job was done. The machine was out of service only 6 hr.

We made six threaded machine-steel plugs 2¼ in. in diameter, 16 threads, 2 in. long. These were made on a Jones & Lamson machine in 1 hr. We put the turret



THE REPAIR ON THE JONES & LAMSON TURRET

plate on the miller and bored and tapped the six 2¼-in. 16-thread holes for the plugs in about 2 hr., which left us 3 hr. to shape the slot, drill and tap the ¼-in. 20-thread holes so the bushings cannot turn, and put the turret on again.

I think this will make a stiffer job than the one submitted by F. W. Snyder, and it is certainly much cheaper.

N. W. WOLLUMS.

Columbus, Ohio.

Avoiding Costly Errors in Indexing Work

The editorial on page 785, Vol. 44, on the subject of errors in indexing work, recalls to mind a former experience. The conclusions then arrived at may be helpful to others.

The job itself was one of division and internal milling. Only what was absolutely necessary to get out the work was done. No trouble was anticipated, as it was proposed that, until the job had passed the experimental stage, the work should be handled in the toolroom, where only experienced men were employed.

For a time all went well; everything was as expected. Then trouble developed. Some difficulty was experienced in tracing its cause, which was found to be the shifting of the sector without the operator's noticing it. Some work also came out that was at once seen to be a "misdivide"—that is, the operator had forgotten the number of turns he had to make for each division and had given

one too many or one two few. The remedy at the time and on that particular job was quickly decided upon. The work in question was held for milling in a pot chuck mounted on the dividing head, the outer end of the chuck being carried in a "steady" mounted on the platen of the machine. As soon as the defective work was found, the front of the chuck was graduated with the correct divisions. An index line was marked on the steady to match. This effectually prevented any further bad work. The operator, after indexing, had only to see that index and graduation were in alignment to be quite sure that all was well.

The question as to what should be done when the job had passed the experimental stage and was ready to be handed over to the regular production staff was then considered. It was decided that with proper jigs the work could be placed upon the plain millers. The matter of simple accurate division was next studied. Direct indexing was ruled out because the number of divisions was large in relation to the diameter, the work with the chuck was heavy and would have to be moved through a small arc, the holes or notches would need to be small and so would not withstand the wear incidental to correct alignment. As it was hardly to be expected that the operator would move the work the correct amount, the wear would of necessity fall upon the plunger and the notch or hole. Universal dividing heads were not admissible with the class of labor employed upon the plain millers. The toolroom operator had made mistakes; they would naturally make more.

The solution decided upon was the construction of dividing jigs in which were embodied a worm and wormwheel. The end of the wormshaft was provided with a spring plunger that entered a hole in a disk. All the operator had to do was to withdraw the plunger, give one turn and again insert the plunger in the hole. Thus there could not be any mistakes.

That was in our case quite satisfactory. In other cases and for finer divisions it would be quite practical to design a worm and wormwheel and provide an index plate in conjunction. The essential feature is that the operator has only to withdraw the indexing plunger from one hole and insert it in the next. This is too obviously simple for anyone to make mistakes. Even if the operator should by any chance miss a hole, the omission can be rectified without error in the result by simply coming round to the missed place as soon as convenient. It will be noticed that this oversight is all that could happen. There could not be a larger or a smaller division. F. R. Mann.

Bournbrook, England.

Attitude of Employers Toward Military Training

Your article on page 956, Vol. 44, recalls to mind the letters which were written some months ago regarding the attitude of employers toward military training, and I refer especially to Percy E. Barbour's reply to Mr. Murphy on the above subject. I also refer to James Vose's recent letter on page 1003, Vol. 44. As an ex-1st Sergeant of a militia company I naturally argue in favor of military training. Few employers realize that the National Guard is one of the greatest aids to discipline in the shops today.

The young man who is enlisted as a private in the ranks soon learns that he has *got to do as he is told* and no questions asked. By faithful duty he is promoted to a corporalship. At this point, it is his first experience as a (to use a shop term) "gangboss." He is in charge of 7 men and each of these men must go to his "boss" for orders. He is accountable for general discipline and personal appearance of his gang and cleanliness around their quarters. As he improves in his ability to handle his "gang," he is promoted to sergeant, which rank compares with that of a section foreman in the shops, because he commands a "platoon," or in other words, a number of "gangs." He finally is appointed a 1st Sergeant, whose rank compares with a shop department foreman.

The "Top" Sergeant is responsible for the discipline of his company, settles all disputes, lays out his "details" (assigns work to the men), and is the one man between the commissioned officers and the enlisted men.

A good commissioned officer, who acts the same as a shop superintendent, will never command an enlisted man to do certain things until he has first spoken to the 1st Sergeant (foreman). By this training he is unknowingly fitting himself for executive positions in the factories. It has been my experience as a foreman in dealing with military trained men that they are the last to ask the "whys" and "wherefores," but on the contrary are most likely to say, "Yes, sir, I'll do it right away."

Foremen, who may read this article, recall to mind men who with military training have worked for you. Does not your experience favorably compare with mine?

The largest electrical manufacturing concern in the world has recognized the National Guard, to the extent of paying their employees who are affiliated with the militia at the rate of $1.50 a day, including Sundays, for all ordered tours of duty. The company commander notifies the manager when these tours of duty will take place, thereby giving the department foreman a chance to lay out his work accordingly. Thomas Prentice, Jr.

Pittsfield, Mass.

Two Thread-Cutting Wrinkles

The two wrinkles described by O. F. Philler, under the above heading on page 601, Vol. 44, are not practical. I don't suppose any of us will sell our calipers in our enthusiasm for the first "stunt," even though it is "no cut-and-try method" and there are "no calipers required." As for the second, the odds are 100 to 1 that the next multiple thread the operator cut he would revert to the old and certain method of counting the gear teeth rather than advancing his compound rest in preferring to be sure instead of sorry.

Here's an old timer's thread-cutting stunt that has advantages. A left-hand multiple thread nut was required. After chucking, boring, opening out for about a sixteenth to correct depth, setting up gears, etc., he proceeded to reverse the cone belt (the lathe not being equipped with a reverse), ground up a screw-cutting tool opposite hand to the boring tool. Then, feeding inward for depth of cut and traversing toward the headstock as in a right-hand thread, he cut the threads, dividing up gear teeth, faced out depth cut and the job was completely finished.

This method eliminates guessing for depth, awkward set up in case of tool breaking, and, lastly—the dreaded stiff neck! John C. Wells.

Dumfries, Scotland.

Editorials

Index

The index for Volume 44, January to June, 1916, is now ready.

Those desiring a copy should make prompt request.

Anti-Efficiency Legislation

The record of the present Congress in regard to anti-efficiency legislation stands as follows at the time of this writing (July 7):

1. Tavenner Bill, H. R. 8,665. This bill prohibits time study, premium or bonus in all Government work. It has been reported favorably to the House, accompanied by minority views showing its vicious nature. It is not likely to be acted upon at this session.

2. Van Dyke Bill, H. R. 8,677. This bill prohibits time study, premium or bonus in the Post Office Department. It is still in the House Committee on Post Office and Post Roads. It may be reported out at any time if the desired ends are not gained by a rider on the Post Office appropriation bill.

3. Post Office Appropriation Bill, H. R. 10,484. This bill is now being considered on the floor of the Senate. Anti-efficiency rider is likely to be offered when the committee amendments are disposed of.

4. Naval Appropriation Bill, H. R. 15,947. This bill has been passed by the House and has been reported to the Senate by the subcommittee of the Senate Naval Affairs Committee. It carries in unchanged form the rider as passed by the House.

5. Fortifications Appropriation Bill, H. R. 14,303. This was passed by the House, June 22. The anti-efficiency rider was passed by a roll call, the vote being 197 to 117. It is now in the hands of the Senate Committee on Appropriations and, so far as the rider is concerned, will probably pass in its present form.

6. Army Appropriation Bill, H. R. 16,460. This was passed by the House on June 26 and carries the Tavenner amendment. It was introduced in the Senate on the same day. It will probably pass with the amendment unchanged.

The prospect staring American manufacturers in the face is that the four great appropriation bills will each carry a rider prohibiting the expenditure of any of the moneys there appropriated for time study, premium or bonus payment on any Government work. In principle and result these laws are just the same as those which might prohibit the use of rules, scales, micrometers or any other measuring tool commonly used in doing work. They are exactly parallel in purpose to the weavers' riots in England some 170 years ago. It is an attempt to abolish by law the use of labor-saving devices.

A brief study of the line-up in the House indicates that those who have voted for the amendment believe they are some kind of friend of the "plain people." On the other hand, those who have voted for the exclusion of these provisions are being classed as friends of the "employers' interests."

By the time these comments are in print, it will probably be too late to object to a part of the riders. However, those that have not actually passed into law should be vigorously protested by every manufacturer in the United States. And beyond and perhaps more important than all this, an active propaganda of education should be started at once to forestall similar legislation next year.

Any movement of this kind is insidious. It is easy enough to forecast the next step. It will be to prohibit the use of such improved methods on all work done by private manufacturers for the Government. Such a situation is intolerable, although not unthinkable. It is high time that the campaign of education should be started to prevent the throttling of improvement in shop conditions through such pernicious legislation.

Mobilization of American Research Agencies

The Engineering Foundation has determined to offer its services to the National Academy of Sciences of the United States, "to accomplish the federation of all the research agencies of the nation—governmental, university and private—with the object of encouraging the application of scientific principles to American industries and the employment of science in the national defense." This plan really calls for the mobilization for the good of the country of all the research laboratories and their personnels throughout the United States. The project was taken up and planned by the National Academy. On behalf of the engineering societies the Engineering Foundation now comes forward and offers to assist by providing a competent executive secretary at a salary of some $12,000 a year.

This movement is one of the earnest attempts at preparedness that are now being made throughout the country. Beyond this broad plan is still another that has for its aim the bringing about of coöperation between men of pure science and men of applied science. The secretary to be appointed by the Engineering Foundation may be the means of inaugurating this coöperation as well as assisting in the work of mobilizing the research agencies.

Both movements hold forth promise of good to American engineering and industry. In the past the man of pure science has been far too apt to hold himself aloof and consider that his interest lay in abstract problems, and too often he did not deign to consider those that had a more practical application unless his aid was specifically sought. It is probable that this attitude will break down when this work of mobilization and coöperation is under way. Once this is done the Engineering Foundation will indeed have accomplished a most worthy piece of work as its initial venture.

It is also hoped that the appointment of an executive secretary capable of handling these big movements will assist in further building up the Engineering Foundation itself. It will be recalled that Ambrose Swasey, of

Cleveland, established this Foundation to be administered "in the interests of scientific research and the good of mankind." The trustees are drawn from members of the four great national engineering societies—the Mechanical, Mining, Electrical, and Civil Engineers. Mr. Swasey's hope in establishing this Foundation was to see it grow and develop somewhat like the great foundation in his home city, known as the "Cleveland Foundation." This was started some four or five years ago by a gift of $200,000 to be administered in studying the needs of the city of Cleveland. The initial gift has been added to time and again until the foundation now has an endowment of $26,000,000.

It is earnestly hoped that other engineers will follow the example and wish of Mr. Swasey, and add to the Engineering Foundation until it reaches a large sum and produces an income capable of bringing great results in the field of engineering research and for the good of mankind. An excellent beginning has been made, for nothing but commendation can be said of the initial move of the trustees in seeking to bring about closer relations between the pure and applied sciences.

Keeping the Workers Cool in Summer

The season is fast approaching when those who labor in factories veritably earn their bread by the sweat of their brows. Warm weather, which was delayed beyond its usual time of appearance, has now arrived.

While investigations have shown that human energy and vitality are not by any means at their lowest ebb during the hot months, still it is an undeniable fact observed by anyone who has labored under these conditions that excessively hot weather has a diminishing effect upon shop production.

There are a number of ways to partly overcome this drawback, one of the remedies being the installation of ventilating systems. Some of the most advanced of these maintain the air at a temperature several degrees lower than that outside. Under these conditions, however, the circulation of air is restricted to certain definite passages, and openings such as windows and doors are kept rigorously closed. Imagination goes a long way in the matter of sense of comfort; and when the worker is confined in an atmosphere of this kind, even though it may be cooler than that outside, he misses the stirring of the air or breeze which through years of habit instinctively spells comfort.

A psychological method of increasing the comfort of the workers under such conditions is the installation of fans that produce an actual breeze. The ordinary electric fan in office or smoking car gives one an instinctive sense of comfort, although, as a matter of fact, it merely handles the same air over and over again, in reality raising its temperature through friction.

Another and more logical remedy for the individual worker is the adoption of a proper summer diet. A sense of high temperature is much more easily brought about by over-indulgence in meat or food of high caloric value during the summer months than through ordinary exercise. A glass of beer at noon may look and taste refreshing, but is far from comfortable in its after-effects. There is an opening for organized effort along these lines on the part of progressive manufacturing companies. It very likely might pay some of them to furnish their employees with meals of proper caloric values even at less than cost.

What Is a Hand Screw Machine?

He who asks for a definition should always remember that peace flees when definitions are being framed. Every attempt to limit accurately the meaning of a word or name, or to distinguish between one machine or tool and others that are similar, brings forth controversy. If any worth-while result is finally obtained it must be through compromises. In spite of these truths a request has come to define a hand screw machine, or at least point out the differences between a hand screw machine and a turret lathe.

The name "turret lathe" is undoubtedly very old. It is descriptive in itself, is comprehensive and seemingly was originally and perhaps even today is properly applied to any type of lathe or turning machine that is provided with a turret to hold a series of cutting tools. Thus it properly seems to include chucking lathes, hand screw machines, automatic screw machines and the so-called semiautomatic lathes used largely for machining castings and forgings.

If this view is right, "turret lathe" is the comprehensive class name and "hand screw machine" the special type name of a certain kind of machine in the broad turret-lathe class. Once we accept this view, we can then try to define or state the features that separate hand screw machines from chucking lathes, automatic screw machines and the various other types in the same general class.

The four principal features that a hand screw machine seems to possess are a hand-operated turret, a hand-operated cross-slide, a hand-operated chuck and a hand-operated wire feed. The hand-operated mechanisms distinguish it from the automatic screw machine and semiautomatic turret lathe, on the one hand, and the possession of the wire feed from the chucking lathe, on the other.

This attempt at definition comes from the thought that the mechanism and possible functions of a machine determine its type rather than the particular work for which it may be used. This viewpoint forestalls any objections to the definition as just written, on the score that hand screw machines when used for second operations do not employ the wire feed and so in operation are like chucking lathes.

The confusion in mechanical terms has often been pointed out. It is a pity that such names are not better fixed, and it is particularly unfortunate that the term "turret lathe" is loosely employed without qualification for so many different kinds of machines. In mentioning them in print, in letters and conversation it is far better to use one of the names of a type, as chucking machine, or hand screw machine, or automatic screw machine, or semiautomatic turret lathe, than to refer to them merely as turret lathes.

The man who never makes a mistake is sleeping under six feet of Mother Earth with unheeding, purposeless winds blowing over him.

Shop Equipment News

Gage-Grinding Machine

For some time the Gem City Machine Co., Dayton, Ohio, has been handling large orders for punches, dies, fine tools, and snap, plug, limit or other gages. For its snap or other gages of that character, it designed and built a special grinder that has been in use in its shop for some time, and which it has now decided to put on the market for use on similar work.

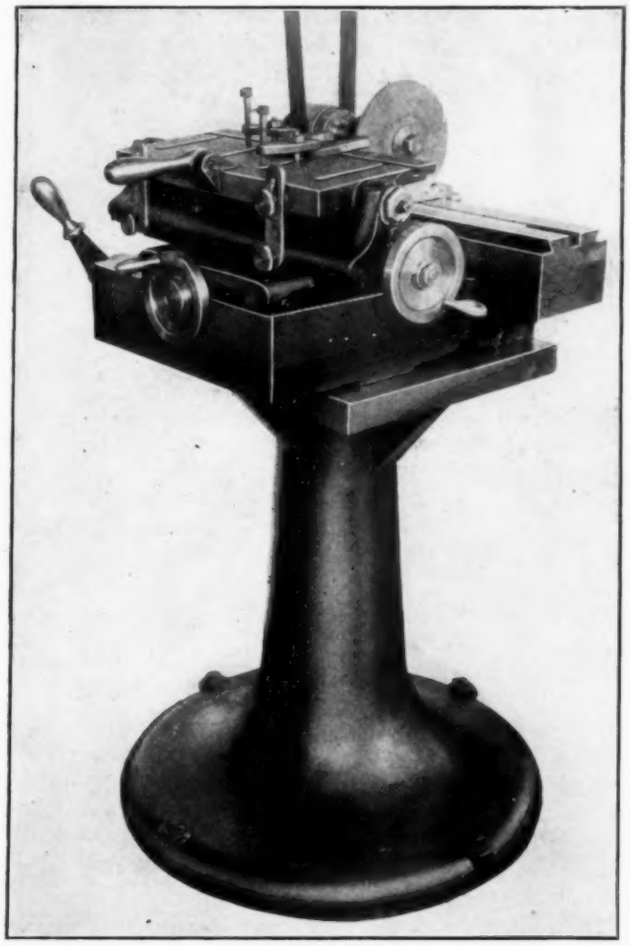


FIG. 1. GAGE-GRINDING MACHINE

Table, 6½x14 in.; table swivels an included angle of 20 deg.; table traverse, screw movement, 4¼ in.; grinding head traverse adjustment, 12 in.; cross-feed handlever movement, 3 in.; size of pulley, 2¾ in.; speed, 2,800 r.p.m.; size of wheel taken, 6x¼ in., ½-in. hole; diameter of base, 22 in.; height overall, 33 in.; weight about 700 lb.

A feature of the machine shown in Fig. 1 is that the stand is made low enough so that an operator can sit on a stool and both manipulate the machine and watch the work to the best advantage. The table is of ample size to take all classes of gages and is equipped with T-slots, bolts and clamps. A setting gage is also used on the table for duplicate work. The table is made to swivel up or down to allow the grinding of thick or thin gages and still keep the center of the work on a line with the center of the wheel.

The machine has a traverse screw feed operated by means of a large handwheel graduated to read to thousandths. The graduations on the rim of this wheel are about ⅛ in. apart, making them very easy to read or to estimate in less than thousandths. The table may be traversed 4¼ in. by means of the handwheel, but if a longer or wider gage is to be ground the head gives an adjustment, in the same direction, of 12 in. The ways on which the head slides are accurately scraped and the head is shifted by means of a rack and pinion movement and securely locked wherever desired. The grinding spindle is made of hardened and ground steel and runs in bronze taper bearings that permit close adjustment. End play is taken up by means of a very sensitive adjustment regulated by one small screw.

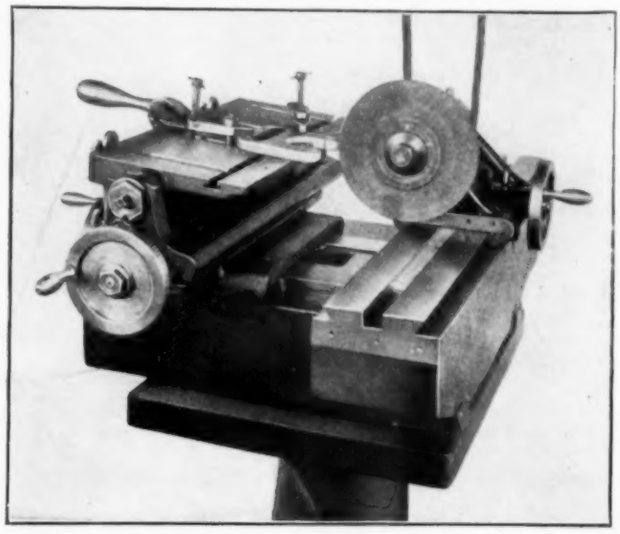


FIG. 2. ANOTHER VIEW WITH GAGE IN GRINDING POSITION

The spindle drive is of the floating type in which the drive pulley runs on a separate sleeve. This eliminates all marks made by the jump of the belt. The spindle is self-oiling, the oil supply being drrawn from a reservoir inside the pulley from which it runs to both the thrust and circular bearings. This reservoir is inclosed with felt oil retainers that prevent leakage when running at high speeds.

The ways on which the head and carriage slide are covered with telescoping brass dustguards, which have been removed for photographing purposes. These guards are lined with felt and are so made as to be absolutely dustproof. The crossfeed is operated by means of a hand lever and rack and pinion. This gives a quick movement for working purposes. Combined with this is an additional movement by means of a fine pitch screw and handwheel. The hand lever is used for removing most of the excess metal, and then the screw feed is used to obtain

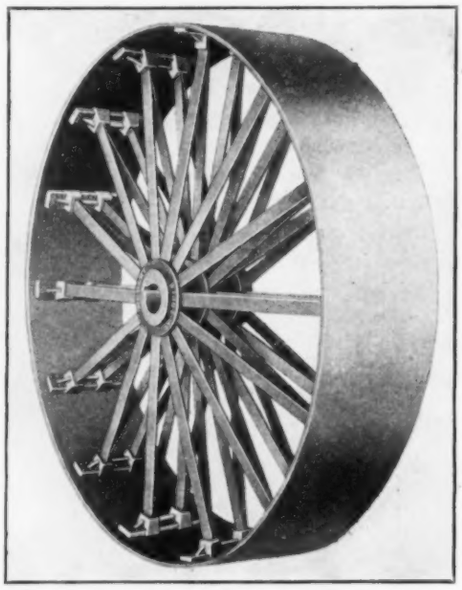
a fine smooth finish and straight face. In actual practice it has been found possible to grind snap gages to within two or three tenths of the given dimensions, and then finish by stoning.

Another view of the machine, with a limit snap gage in place, is shown in Fig. 2. This gives a good idea of the entire mechanism of the head and table.

Heavy-Duty Pulley

In the design of the type of pulley illustrated the aim was to provide for heavy duty and at the same time keep the pulley light.

The arms are made of flat wrought steel. The hubs and rim lugs are of semisteel and are cast onto ends of



HEAVY-DUTY PULLEY

Diameters, 3 to 15 ft.; face width, up to 50 in.

arms that are of a shape designed to provide a solid anchorage.

This form of pulley is made by the Medart Patent Pulley Co., St. Louis, Mo., in three styles—namely, single- and double-arm whole type and double-arm split type.

Universal Grinder

While built along the same general lines as this firm's former machines, the latest type of universal grinder made by the Thompson Grinder Co., Springfield, Ohio, has been changed and improved in numerous ways. Most of the changes are for the purpose of making easier the work of the operator or to meet special shop conditions as demonstrated by use during the last two or three years of actual practice.

In the first place this grinder was designed to combine in a single machine efficient means for the rapid and accurate production of the varied grinding required in a machine shop. The grinding wheel is maintained in a fixed position at all times, and the table carrying the work is adjustable to any desired position relative to the wheel.

The principle of carrying the grinding-wheel head rigidly mounted on a central column solidly attached to the base, around which a heavy bracket mechanism revolves, makes an unusual form of design for a heavy grinder. The revolving bracket moves on a bearing on the base and carries the elevating knee, carriage and table. This arrangement allows the table to be adjusted to a position at right angles to the wheel spindle at either end, parallel with it or at any intermediate position. Accordingly, the machine can be converted

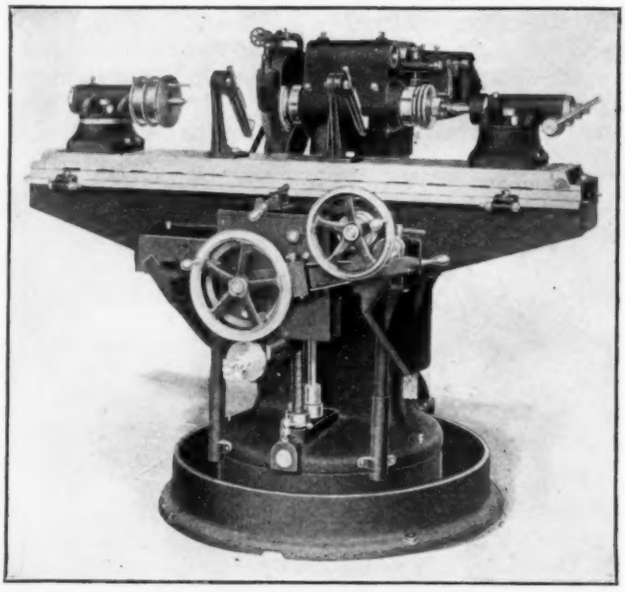


FIG. 1. UNIVERSAL GRINDER

Capacity: Cylindrical grinding, 10 in. in diameter by 36 in. long; surface grinding, 8 in. wide by 48 in. long; internal grinding, up to 12-in. depth, according to attachments used; knife grinding, 48 in. long; milling cutters, up to 20 in. in diameter; grind taper per foot, 3 in.; automatic longitudinal feed to table, 48 in.; automatic crossfeed, 8 in.; hand vertical adjustment to knee, 10 in.; speed changes to table, 5; speed changes to headstock, 4; speed of main spindle, 1,830 r.p.m.; horsepower required, 3; main spindle bearings, 1⅝x4 in.; headstock spindle bearing, 2x9 in.; main spindle pulley, 3½x3½ in.; headstock swivels 90 deg. each way; countershaft pulley, 10x4 in.; speed of countershaft, 400 r.p.m.; base, 40 in. in diameter; maximum floor space, with full table travel in all positions, 11x11 ft.; net weight, 3,600 lb.; gross weight, 4,300 lb.; dimensions boxed for export, 48x45x78 in.

into a plain grinder for straight or taper work between centers, a surface grinder, an edge grinder, a die grinder, a cutter grinder or an internal grinder. Fig. 1 illustrates the machine set for plain cylindrical grinding, and Fig. 2 shows the table swung at right angles to the spindle for surface grinding. By using a cup wheel this same position serves for edge or knife grinding.

The controlling lever, which starts, stops or reverses the table, is placed on the clutch box immediately in front of the operator. A slight movement of this lever disengages the clutch and stops the table, leaving it free to be operated by the handwheel. The lever controlling the table speeds is placed on the side of the gear box on the rear of the grinding-wheel head and by means of a circular rack and sliding key permits five table speeds ranging from 28 to 128 in. per min. The headstock speeds are governed by the four-step cone pulleys on the countershaft drum and counter. The motion is transmitted through a friction clutch in the drumshaft cone, giving headstock speeds ranging from 30 to 300 r.p.m.

The base is cast integral with the reservoir and has a settling basin open at the top, permitting easy cleaning. The inner column is of box design, rigidly attached to the base on the bottom and to the grinding-wheel

head on top. It also carries the lower bearing for the power-feed shaft. The rear column is also of box design, rigidly attached to base and wheel head, thus making the base and inner column an unyielding unit or frame for the support of the grinding-wheel head. The outer column has an annular bearing on the base and is clamped in any position to suit the work. When this column is to be rotated, a slight movement of a lever brings into action a set of roller bearings that make the movement easy.

The sliding table has a reciprocating movement on the carriage, controlled by dogs operating against the

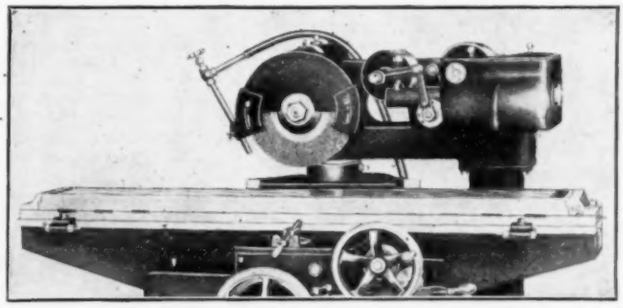


FIG. 2. ARRANGED FOR SURFACE GRINDER

reverse lever. These dogs have a special fine adjustment to permit grinding against shoulders. The swivel table has its bearing on the sliding table and can be set at any angle with the ways, allowing tapers to be ground without disturbing the alignment of the headstock and tailstock centers. It is graduated to read taper in inches per foot. It has three T-slots in it. The headstock swivels and has a graduated base. Its spindle is bored for No. 3 Morse taper shanks. It is also fitted with pulleys for both live- and dead-center work. The tailstock is secured to the table in the same manner as the headstock. It has a device for holding a diamond-tool holder, so the wheel may be trued without removing the work.

The tailstock spindle is bored the same as the headstock spindle and is fitted with a quick-acting lever and a variable-tension spring controlled by a wheel, or it may be clamped solid. The automatic crossfeed is equipped with a lever on which are mounted two pawls engaging with a ratchet on the handwheel, from which a feed variation of one-quarter to four-thousandths is obtained at each reverse. The feed is automatically thrown out when the work is to size, by setting the stop on the ratchet wheel. The pump used is of the centrifugal type, with bearings above the water level, but with the runner immersed at all times, doing away with the necessity of priming. Either plain or universal equipment is furnished on order.

Plain Miller

The machine shown in Fig. 1 is an improved model of the No. 33 miller made by the Kempsmith Manufacturing Co., Milwaukee, Wis. Various modifications have been adopted to meet manufacturing conditions, both in making and use.

Changes in rate of feed and speed are made by means of change gears, mechanism for which is inclosed in a single easily accessible gear box. Narrow guides are now used on the column, and a new driving clutch, of the expansion ring type, is placed at the back. The top is much stronger than heretofore, and the ways are changed to the 45-deg. type. The table is operated by

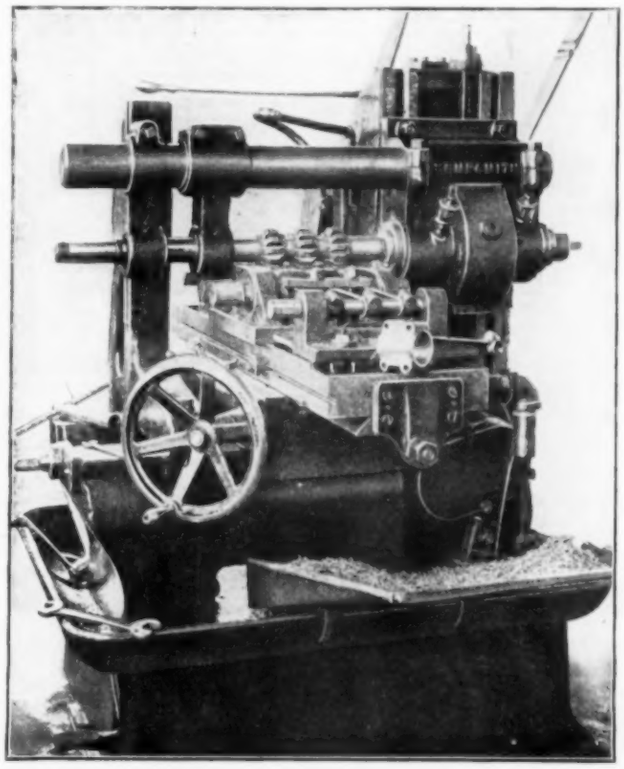


FIG. 1. IMPROVED NO. 33 PLAIN MILLER

Longitudinal power feed, 36 in.; hand crossfeed, 10 in.; vertical adjustment of spindle by hand, 11 in.; maximum distance from top of table to center of spindle, 12 in.; height of table above floor, 37¾ in.; power quick traverse, 100 in. per min.; driving pulley, 500 r.p.m.; diameter of driving pulley, 12 in.; width of double belt, 4 in.; six spindle speeds, ranging from 25 to 152 r.p.m.; six changes of power feed in either of two series, ranging from 1 to 8 in., or 2⅝ to 8-in. table travel per minute; total floor space, 64x106 in.; net weight, about 4,500 lb.

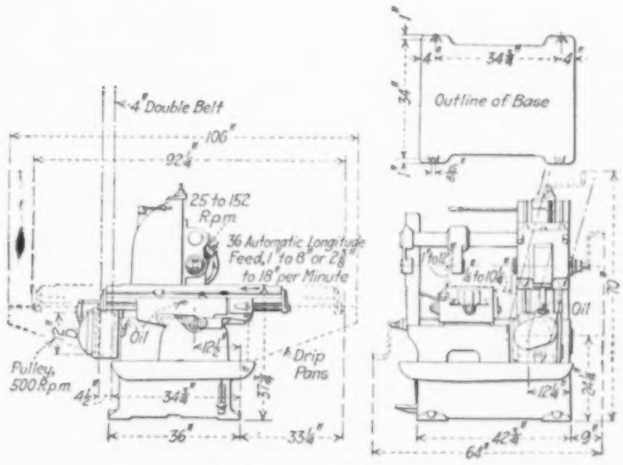
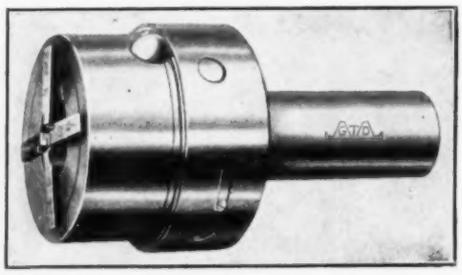


FIG. 2. DETAILS OF PLAIN MILLER

a lead screw instead of a rack, and a quick traverse is provided. The bed and base are cast in one piece, and the pump is placed outside. Fig. 2 shows some of the details.

Self-Opening Die

In the form of self-opening die shown, the latest addition to the line made by the Greenfield Tap and Die Corporation, Greenfield, Mass., the self-opening die principle used in the former products of this company has been retained. Guarding the opening for the chaser setscrews



SELF-OPENING DIE

and substituting a ball-shaped latch for opening the die when the cut is finished constitute the main improvements.

The formerly exposed chaser-setscrew openings are covered by a light steel shell that prevents dirt and chips from entering, with the possibility of marring the work. The shell can be turned to expose the screws in order to release and remove the chasers.

The die is designed to be particularly applicable in cases where the work is stationary.

NEW PUBLICATIONS

GRINDING MACHINERY. By James J. Guest. 440 pages; 5½x8½ in.; cloth. Published by Longmans, Green & Co., New York. Price, $4.20 net.

The author has used considerable care in the selection of material and shows many of the latest types of grinding machines from various makers, both in this country and abroad. The book includes much detail as to parts, particular attention being devoted to reversing and cross-feed mechanisms, steady rests, details of head construction and also the methods of belting for the various functions.

The author takes exception to the acceptance of standard speeds for work being ground and advocates that they be varied according to the material, the kind of wheel used and other conditions. He gives the work speeds advocated by several of the best-known builders of grinding machines and supplements them with a table of his own in the appendix. All who are particularly interested in grinding machinery will find the book of great assistance.

SAFETY ENGINEERING APPLIED TO SCAFFOLDS—Three hundred and thirty-nine 6x9-in pages; 127 illustrations; indexed; cloth bound. The Travelers Insurance Co., Hartford, Conn. Price, $3.

This book should be in the working library of every plant engineer. The literature on the subject of scaffolds is exceedingly meager. In fact, this is the only book that describes American practice with anything like completeness. It is based upon the results of the experience and observation of the engineers of the Travelers Insurance Co. in their regular work of inspection and research.

For the reason that scaffolds are for temporary use only, they are commonly badly designed and badly built. Too often the materials in them are poor in quality and deficient in size and quantity. It appears to be a widespread and almost universal belief that a scaffold is not worth anybody's serious study. Any workman who can drive a nail is looked upon as competent to lay out and build a scaffold, and anything that may happen to lie at hand is good enough for material. As a result many such temporary structures are dangerous to life and limb, as is amply proved by some ten pages of reprinted newspaper clippings gathered during June, July and August, 1911. They aggregate 92 scaffold accidents, or precisely one per day for the period studied.

The work is comprehensive, taking in as it does simple platforms and horse scaffolds, used for interior painting and decorating, and at the other extreme the well-designed, carefully constructed scaffolding for a skyscraper like the Woolworth Building or for decorating a huge room like the concourse of the Grand Central Terminal in New York City. Scaffolds of some kind between these limits are in daily use in every shop and factory. The engineer in charge should acquaint himself with the best available knowledge on the matter of design, construction and use of these temporary structures.

The field covered by the book is indicated by the headings of the 13 chapters, which are: Reality of the Scaffold Hazard, Scaffolds Considered Generally, Bricklayers' Pole Scaffold—American Practice, Independent Pole Scaffold, Lashed Scaffolds; Other Forms of Pole Scaffold, Special Safety Features, General Features and Operations, Building with Horses, Suspended Scaffolds for Construction Work, Scaffolds of Other Kinds, Structures Similar to Scaffolds, General Counsel.

The mechanical features of the book are far above the average, and the illustrations are excellent.

FORD METHODS AND THE FORD SHOPS—By Horace Lucien Arnold and Fay Leone Faurote. Four hundred and forty 7x10-in. pages. Published by the Engineering Magazine Co., New York City. Price, $5.

This book is a reprint of the articles that appeared in the "Engineering Magazine," the main part being by Horace L. Arnold, well known as a contributor to the "American Machinist" in years gone by, and the remainder, completed after Mr. Arnold's death, by Mr. Faurote.

Opening with a chapter on the characteristics of Henry Ford and the beginning of the Ford Motor Co., the book takes up the various departments in detail and gives a wealth of information concerning methods, machines and time required. There are 16 chapters, beginning with the Genius of the Plant and ending with Safeguarding the Workmen. In between come chapters on Stock System and Employment Methods, How the Work Is Done, Inspection and Assembly, Motor Test Blocks and Chassis Assembly, Machining and Assembling the Front Axle, The Crankshaft, Piston and Piston Rings, The Commutator, Production and Assembly, Sheet-Metal Work, Conveyors, Work Slides and Roll Ways, The Bushing Job, Special Machines and Fixtures, The Foundries, Finishing the Bodies, and New Factory Conditions.

Practically every problem of shop management seems to be contained in this plant and is so recorded in this book that no one responsible for production can fail to absorb many valuable ideas from it. True, many of the methods will have to be modified to suit other conditions, but they are none the less valuable on that account.

The whole system of shortening the travel of material, which plays such an important part when over 140,000 lb. of material is moved per day, is brought out in detail.

The questions of hiring and firing, of the health of employees, of the use of unskilled workers, together with the forms employed, are all considered. A commendable plan of having employees fill out a card as to the work in which they believe they can be more valuable than in their present occupation is described.

The work of the shortage chaser is given in detail; and as the steady flow of material to the assembly department is a vital problem in any large shop, this description is of particular interest. Every hour shows just how all departments stand in their supply of parts.

The methods of both machine shop and foundry are illustrated. The sequence of operation, the time required, the shop layout that makes it possible and much else of interest are given. In fact, we know of no other instance where such detailed information has been made public except in connection with the articles in the "American Machinist" on the manufacture of munitions.

The chapter on inspection and assembling is of particular value, for inspection is thorough in order to prevent unnecessary machine work being done on imperfect parts. The reduction of time for assembling is shown in considerable detail and contains many valuable suggestions, among them a comparison of individual assembly of a complete part requiring six operations and the result of dividing this work among three men. Great care is taken to have benches and other assembly devices, such as continuous carriers, at the best height for easy reach—"work high," as it is called. These heights vary from 24½ to 35 in., according to the work being done. This idea is also being applied more and more to machines, so as to bring them to the most convenient height. Minute details of the motor assembly are given, 84 operations being mentioned, with the men required and the number of seconds for each.

Many of the machining operations are also given in detail, both as to sequence and time required; these data should be of service in many shops, even on other lines of work. Crankshafts, pistons, commutators, bushings, gasoline tanks, radiators, etc., are taken up in similar detail.

There is so little specific information available on modern foundry methods and costs that the chapter on this subject should be especially interesting. The size of the foundry alone at once attracts attention—with 1,450 men, melting 192 tons of iron, handling 1,906 tons of sand and pouring 40,450 pieces of an average weight of 8.9 lb. per day. Painting and varnishing of bodies are also treated in detail as to methods, output and the time required.

For both study and reference the book is to be commended to shop executives, planners and those who have to do with production. The only criticism is the failure to mention specifically the work of such men as C. H. Wills, who has been so long associated with Mr. Ford, as well as the chief tool designer, C. Emde, and others. Of course, such a result can only be achieved by the coöperation of many, and the omission may be due to the endeavor to avoid injustice by unintentional omission.

MECHANICAL ENGINEERS' HANDBOOK—By Lionel S. Marks, editor-in-chief. First edition. One thousand eight hundred and thirty-six 4½x7¼-in. pages; limp leather binding; thumb index. McGraw-Hill Book Co., New York City. Price, $5.

Reviewed by JOSEPH W. ROE*

Seventy-two years ago Charles Haswell brought out the first edition of his "Engineers' and Mechanics' Pocket-Book." Though general in its nature, its modest size, 264 pages, justified the name "Pocket-Book." It grew from year to year and passed through more than 70 editions, establishing the value of this type of book, and it has led to many similar volumes dealing with special branches. This was inevitable with the vast growth of engineering science and its spread into intricate and widely differing fields. The name "Pocket-Book" still lingers on some, though they have long since grown too bulky for any normal pocket. The present book, the latest of this kind, wisely uses the name "Handbook," which it literally is—a book of reference to be kept at hand on the desk or elsewhere.

Most of these books have been compiled by one man, or by a small group of men. The only reference work for mechanical engineers compiled by a large group of specialists has been the three-volume German book "Hütte," now in its twenty-second edition, which includes civil and electrical engineering as well as mechanical engineering. The present "Handbook" is intended to supply the practicing engineer and the student with a comprehensive and authoritative reference work in mechanical engineering, and it was felt that in a major division of engineering the coöperation of a large number of specialists, as in the "Hütte," is now necessary if a book of this character is to have reliability and adequate authority. It is therefore the work of 50 specialists, with Professor Marks as editor-in-chief, and has been founded in the "Hütte."

The contributors have been well chosen and will carry weight by their authority. The more important sections of the book are the work of several men. That on the Properties of Engineering Materials, for instance, is handled by 13 specialists. Other topics are cared for by separate writers, each familiar with the particular subject. In addition to this many of the sections were submitted to various manufacturers and specialists for corrections and suggestions.

The general arrangement of the "Hütte" has been followed. The presentations of some of the more theoretical subjects follow it closely, others in a general way; but those portions dealing with American engineering practice are almost wholly new.

The "Handbook" contains the usual mathematical tables. These are carried out to only four significant figures, which limits their usefulness for some purposes, but allows space for a more complete treatment of general mathematics than has been usual in books of this character, and for a new and very valuable section on the Graphical Representation of Equations. The theory of mechanics, heat and strength of materials has been brought out in condensed, but clear form, which will make these sections of great value to the engineering student. The one on heat is particularly good and includes much new material and many tables and diagrams. In all these sections a much greater familiarity with mathematics is assumed than in previous handbooks.

The presentation of materials of engineering is full and well arranged, including not only full information and specifications on iron, steel, the alloys and fuels, but also on concrete, brick, wood, lubricants, abrasives, belting, insulation, paints, roofing materials and a wide variety of articles used by engineers.

The other main sections cover Power Generation, Hoisting and Conveying, Transportation, Building Construction and Equipment, Machine-Shop Practice, Pumps and Compressors, Electrical Engineering, Engineering Measurements, etc. Much new matter will be found under Materials, Power Generation, Conveying Machinery and Buildings. A number of the subsections are wholly new, as those on Aëronautics, Air Conditioning, Accident Prevention, Centrifugal Air Compressors and the A. S. M. E. Testing Codes.

The subdivision of the book into well-defined sections is distinctive and comes as a natural result of the staff authorship. The preliminary index to the major topics, printed inside the covers, taken in conjunction with the thumb tabs and subtables of contents at the head of each section, renders the material more readily accessible than in any other handbook known to the reviewer. An excellent table of references is usually found at the head of each subsection, covering the subject matter of that section. Black-faced type, judiciously used, emphasizes the important subjects in the longer paragraphs. There are about 1,000 illustrations, which include many charts and heat and stress diagrams. The critical reader will find a few mistakes in the text and in some of the illustrations, but this is inevitable in a work of this magnitude. These errors will, no doubt, be eliminated in later editions.

The staff authorship of this book, its skillful editing, the uptodateness of its material and the form and accessibility of its information make this the best handbook yet issued for engineers. It will prove of more assistance to students than any before available, without losing any of its value as a reference book for the practicing engineer.

*Assistant Professor of Machine Design, Sheffield Scientific School, Yale University.

PERSONALS

L. H. Mesker has been appointed sales manager of the Kearney & Trecker Co., Milwaukee, Wis., with direct supervision over the sales in the Ohio territory.

Wallace R. Johns, for the past 11 years associated with the Somers, Fitler & Todd Co., Pittsburgh, Penn., has been appointed manager of its machine-tool department.

F. C. Riddik, formerly general superintendent of the Railway Steel-Spring Co., Chicago Heights, Ill., has become general manager of the Kennedy-Stroh Corp., Oakmont, Penn.

Frank Lundgren, until recently superintendent of the Krajewski-Pesant Co., Brooklyn, N. Y., has become superintendent of the Farrell Foundry and Machine Co., Ansonia, Conn.

W. M. Henderson, formerly assistant superintendent of the frog, switch and signal department of the Steelton plant of the Pennsylvania Steel Co., has accepted a position as assistant works manager of the Taylor Iron and Steel Co., Easton, Penn.

FORTHCOMING MEETINGS

American Foundrymen's Association and American Institute of Metals. Annual meeting, September 11-16, Cleveland, Ohio. A. O. Backert, secretary, American Foundrymen's Association, Cleveland, Ohio.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	July 7, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$14.00	$14.75	$9.75
No. 2X Northern Foundry, New York	19.75	20.25	14.25
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.75
Basic, Pittsburgh	18.95	18.95	13.60
No. 2X, Philadelphia	19.75	20.25	14.25
No. 2, Valley	18.25	18.00	12.75
Basic, Eastern Pennsylvania	19.50	20.00	13.75
Gray forge, Pittsburgh	18.70	18.70	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger, tees 3 in. and larger and plates ¼ in. and heavier, from jobbers' warehouse at the places named:

	New York				
	July 7, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.25	3.50	1.85	3.25	3.10
Steel T's, base	3.30	3.55	1.90	3.25	3.10
Machinery steel (bessemer)	3.25	3.50	1.80	3.25	3.10
Plates	4.00	4.25	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	July 7, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.65	2.60	3.20	3.20
No. 26 black	3.55	3.55	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.50	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.45	2.40	3.00	3.00
No. 16 blue annealed	4.45	4.45	2.35	3.70	3.60
No. 14 blue annealed	4.35	4.35	2.25	3.60	3.50
No. 12 blue annealed	4.30	4.30	2.20	3.55	3.45
No. 10 blue annealed	4.25	4.25	...	3.50	3.40
No. 28 galvanized	5.40	5.65	6.00	5.20	5.10
No. 26 galvanized	5.10	5.35	5.70	4.90	4.80
No. 24 galvanized	4.95	5.20	5.55	4.75	4.65

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black		Galvanized	
	July 7, 1916	One Year Ago	July 7, 1916	One Year Ago
⅜ to 2 in. steel butt welded	70%	79%	50½%	57½%
2½ to 6 in. steel lap welded	68%	78%	48½%	56½%
Diameter, In.				
¾	3.45	2.42	5.69	4.89
1	5.10	3.57	8.42	7.23
1¼	6.90	4.83	11.39	9.78
1½	8.25	5.78	13.61	11.69
2	11.10	7.77	18.32	15.73
2½	18.72	12.87	30.13	25.45
3	24.48	16.83	39.40	33.28
4	34.88	23.98	56.14	47.42
5	47.36	32.56	76.22	64.38
6	61.44	42.24	98.88	83.52

From New York stock the following discounts hold:

	New York		Cleveland	
	Black	Galvanized	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%	64%	44%
¾ to 3 in. steel butt welded	64%	42%	66%	46%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	July 7, 1916	Three Months Ago
Pittsburgh, mill	2.50	2.45
Warehouse, New York	3.25	3.10
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	July 7, 1916	Three Months Ago
New York	20% above list	15% above list
Cleveland	20% above list	20% above list
Chicago	10% above list	List price

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York					
Today	One Year Ago				
$6.00	$3.75@4.00	Cleveland	$6.30	Chicago	$5.25

In coils an advance of 50c. is usually charged.

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets $2.25 Bars $3.00

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	July 7, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	28.00	29.00	20.25
Tin	39.00	45.00	38.50
Lead	6.50	7.00	5.75
Spelter	10.00	13.75	22.00
ST. LOUIS			
Lead	6.37½	7.00	....
Spelter	9.75	13.62½	....

At the places named, the following prices in cents per pound prevail:

	New York				
	July 7, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	37.50	25.00	37.50	37.50
Copper wire (carload lots)	37.50	37.50	28.00	33.00	38.00
Brass rods, base	44.50	44.50	25.37½	38.00	40.00
Brass pipe, base	46.50	46.50	29.00	45.00	46.00
Brass sheets	44.50	44.50	25.37½	42.00	38.00
Solder ½ and ½ (case lots)	25.12½	28.00	27.50	27.00	25.50

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland	
	July 7, 1916	One Year Ago	July 7, 1916	Three Months Ago
Copper, heavy and crucible	21.00	16.50	20.00	22.00
Copper, heavy and wire	20.00	16.25	19.50	21.00
Copper, light and bottoms	17.00	14.00	17.00	18.00
Lead, heavy	5.00	4.25	5.75	6.50
Lead, tea	4.50	4.00	4.25	5.50
Brass, heavy	11.75	11.50	12.00	18.00
Brass, light	9.25	10.00	10.00	12.00
No. 1 yellow rod brass turnings	12.75	....	12.00	16.25
Zinc	7.50	13.00	7.00	14.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
⅜ to ½	35.50	36.00	36.50	37.00	38.00
⅝ to 1⅛	35.25	35.75	36.25	36.75	37.75
⅜ to 1⅞	35.00	35.50	36.00	36.50	37.50
1⅛ to 2⅞	35.75	36.25	36.75	37.25	38.25
Rounds					
3 to 3⅛	36.50	37.00	37.50	38.00	39.00
Squares					
3	36.50	37.00	37.50	38.00	39.00
Rounds					
3⅛ to 3⅛	36.25	36.75	37.25	37.75	38.75
Squares					
3⅛ to 3⅛	36.25	36.75	37.25	37.75	38.75
Rounds—Squares					
4 to 4⅛	37.00	37.50	38.00	38.50	39.50
5 to 6⅛	38.00	38.50	39.00	39.50	40.50
7	38.50	39.00	39.50	40.00	41.00
Flats	36.50	37.00	37.50	38.00	39.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.
Hexagon bars 2c. per lb. over corresponding size of round rods.
For cutting to any specified length not shorter than 1 ft. add 1c. per lb.
The scrap allowance is 18c. per lb. delivered at works.

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 18.00

	In Casks		Broken Lots	
	July 7, 1916	Three Months Ago	July 7, 1916	Three Months Ago
New York	20.00	26.00	21.00	26.50
Cleveland	22.50	26.00	23.00	26.50
Chicago	21.00	....	21.50	....

Copper Bars from warehouse sell as follows in cents per pound:

	July 7, 1916	Three Months Ago
New York	43.00	40.00
Cleveland	40.25	33.50
Chicago	40.50	38.00

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	55.00	47.25	55.00
Commercial	25.00	43.00	21.00

Copper Sheets—In New York, from warehouse, hot rolled 16 oz. (large lots) base per lb. is 37.50c.; cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

Jigs and Tools Used in Making Pipe and Other Wrenches

By Ethan Viall

SYNOPSIS—While the methods of machining these wrench parts may vary some with different-sized members of the same group, yet the work shown is well standardized. Most of the jigs are simple and easily operated for the removal or insertion of work.

In making the class of small tools described in this article not only must they be well designed and nicely balanced, but tools and jigs must be provided for making commercially accurate and interchangeable parts in an economical manner. These tools and jigs must not be so difficult to make nor so highly finished as to eat up too large a percentage of the profits. These fundamental conditions seem to have been well met by the Mechanics Tool Co., Rockford, Ill., in its factory equipment and product.

The product consists of a varied line of pipe wrenches, pliers, nippers, nail cutters, end wrenches and the like. Each kind of tool is made in sizes sufficient to meet almost every conceivable requirement. A fair idea of the class of tools made may be had by reference to Fig. 1, where six varieties and several sizes are shown. The ones at the left are known as eagle-claw wrenches and may be used for a large number of purposes. Some of their applications are illustrated in Fig. 2 and will be readily understood. While these special wrenches have many different forms and sizes, the general principle on which they are made is the same. Other tools shown differ only in minor details from many with which the reader is already familiar. All the handles or principal parts of these tools are drop forged from a suitable grade of steel. A few of the forgings, with the flask still in place, may be seen in Fig. 3.

In describing the work on some of these tools we will begin with pipe wrenches of the more common sort, shown at the top in the first illustration. The adjustable jaws for these wrenches are made in two ways. The larger sizes are drop forged in a die that also forms the thread on the stem for the adjusting nut. On some of the smaller sizes the stem is forged round and afterward hollow-milled and threaded. The hollow milling is done with a self-opening die head like the one seen at the left in Fig. 4. This is a regular thread-cutting head fitted with milling jaws, as shown. The head is held on the spindle of a heavy drilling machine, and the work to be milled is fastened to the table by a two-jawed universal chuck fitted with formed false jaws. After being hollow-milled, the work is placed in a jig like that shown at the right, and a hole is drilled lengthwise of the stem. In this jig the work is placed with the milled stem in a vertical V-groove and is clamped in place by the ring clamp *A*, which is removed, for the insertion or removal of the work, by slip-

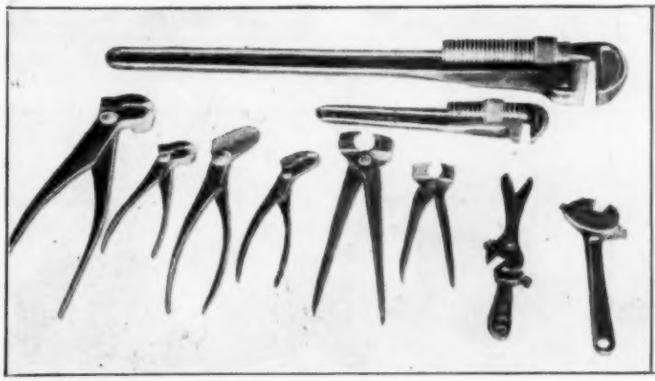


FIG. 1. A FEW OF THE WRENCHES MADE

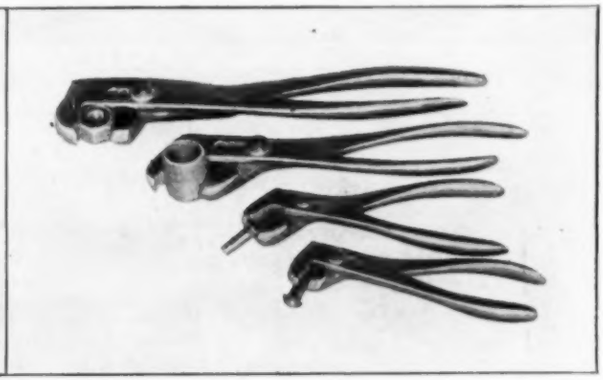


FIG. 2. METHODS OF GRIPPING WITH CLAW WRENCH

FIG. 3. DROP-FORGED WRENCH PARTS

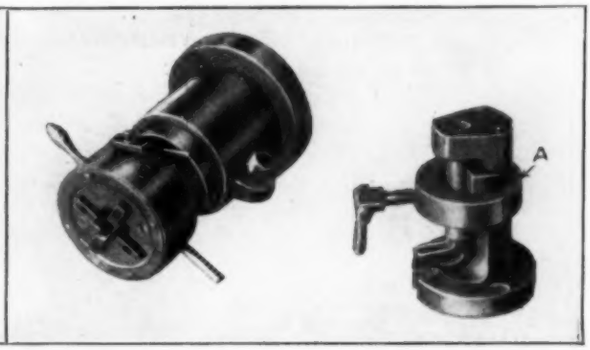


FIG. 4. DIE HEAD USED AS A MILL, AND A DRILLING JIG

ping it up off the jig. Another form of jig for this same work will be shown later. After these pieces have been milled and drilled, they are threaded for the adjusting nut, using a self-opening die head and holding the work exactly as for hollow-milling.

All the adjustable jaws for pipe wrenches are drilled lengthwise of the stem, whether they come with the threads ready forged on them or not. After they are drilled, they are placed in a jig, Fig. 5, and a slot is milled lengthwise so as to cut through into the drilled hole. As can be seen, the wrench jaw is placed with the drilled hole over the end of the slotted tail center *A*, and the head end *B* is held between the formed jaws of a chuck. The setscrew *C* forces the work solidly against the tail center and prevents any tendency to work loose during the cut.

The next operation on these adjustable jaws is to mill the "teeth" in them. This is done by placing the work in a vise fitted as shown at the right in Fig. 6. The work *A* is placed against the grooved vertical post *B* and locked in by turning the handle *C*. The teeth are then milled at *D* with a formed mill.

The recess for the adjusting nut is finished in a gang jig, seen in the foreground in Fig. 6. The number milled at a time depends on the size, as various holding jigs are provided. In the one shown, twelve are placed at a time, and a milling cutter is run through at *E*. The teeth on the contact end are milled with a formed mill held in a vertical spindle. Some are milled in gangs, while the larger ones are milled one at a time, held as at *F*.

The large sizes of pipe wrenches have steel pieces inserted in the contact ends of the backs, as at *A*, Fig. 7. These inserted pieces are shaped as shown at *B*. The pin hole in the back is drilled in the jig seen at the back, and the pin hole in the inserted piece is drilled as at *C*. The operation of both of these jigs is apparent.

In the type of pipe wrench just shown it is necessary, in order that a good grip may be obtained, for the ad-

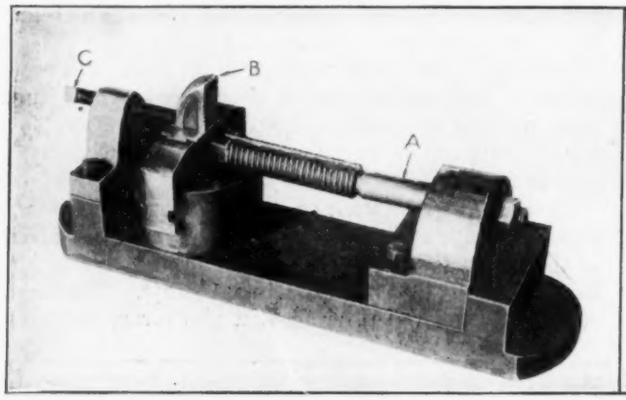


FIG. 5. JAW SLOT-MILLING JIG

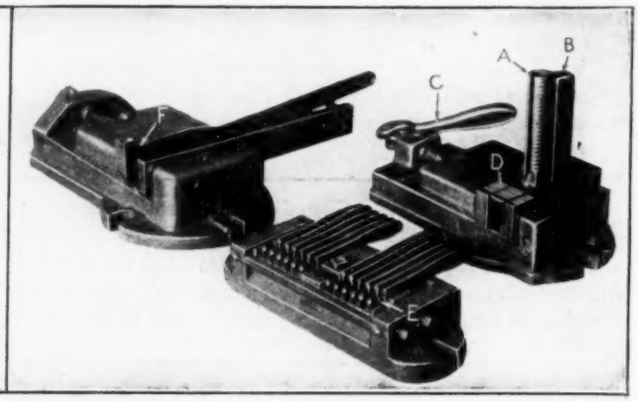


FIG. 6. THREE MILLING JIGS

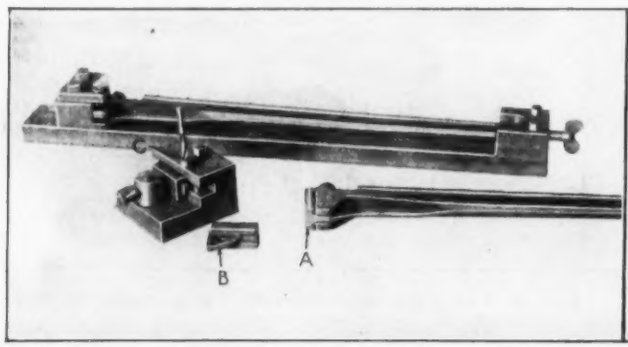


FIG. 7. LARGE WRENCH JIGS

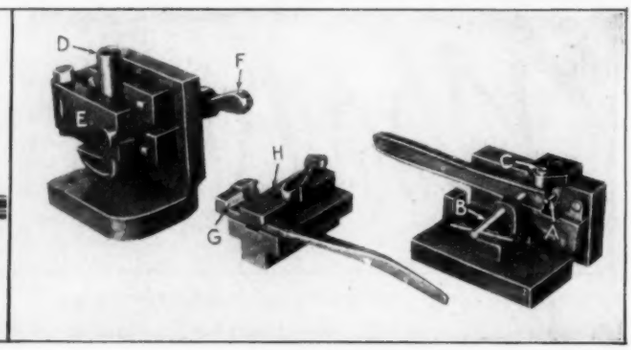


FIG. 8. TWO DRILLING AND A MILLING JIG

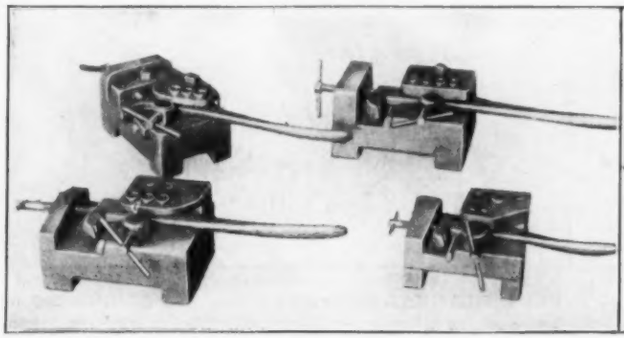


FIG. 9. JIGS FOR PIVOT-SHIFTING HOLES

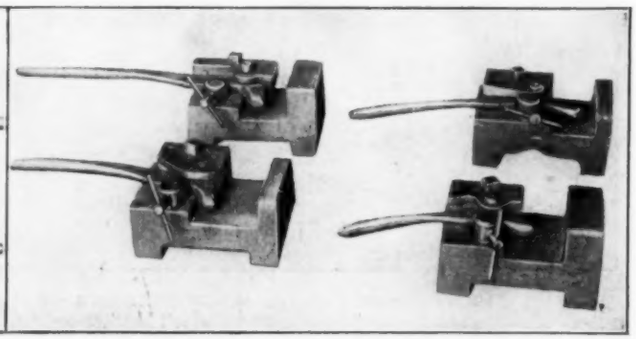


FIG. 10. PIVOT PIN HOLE JIGS

justable jaw to be held back until a grip is taken on the pipe. This is done by inserting a small coil spring between the jaw stem and the back of the handle. The hole for this spring is drilled as shown at the right in Fig. 8. The handle is placed in the jig and butted against the pin *A*. The clamp screw *B* is then tightened, and the hole is drilled through the bushing *C*.

At the left in this illustration is shown another jig for holding the adjustable jaw while drilling the hole lengthwise of the stem. This jig differs considerably from the one first shown and is a type used mostly on the larger sizes. A simple cap with a bushed hole in it is used to center with, and then the hole is drilled in the usual way. The piece *D* is placed in the jig in a vertical V-groove, and then the hinged clamp *E* is swung into place and locked by means of the bolt and eccentric lever *F*.

In the middle in Fig. 8 is a simple milling jig for holding eagle-claw backs while milling a cut at *G* to give the proper finish and clearance. The wrench back is located by means of the rivet holes drilled in it, which fit over pins in the jig. The clamp *H* is slotted so as to slide forward or back under its retaining bolt and is locked when in position by a screw operated by the lever.

These plier-like claw wrenches are all made so that the pivoting point may be shifted to two or more positions. This arrangement gives each wrench considerable range in firm gripping within its capacity. The principle of a flattened pivot pin and several pivot holes connected by slots narrower than the holes, on which this shifting is based, is familiar to all readers. The jigs for drilling the shift holes are illustrated in Fig. 9. All are made on the same plan, and they differ only in the number of holes to be drilled and the size or angle of the wrench back. The gripping jaws carry the pivot pin and in consequence have but one hole drilled in them. The type of jig used is seen in Fig. 10.

On a few of the smaller sizes the shifting holes are punched instead of being drilled. This is done with the punch and die shown in Fig. 11. Teeth on the jaws of the claw wrenches are milled as in Fig. 12. The jig at the right is for wrench backs, and the one at the left is for the gripping jaws. While these jigs are for but one size, the jigs for the others are of practically the same design and differ merely in variations of the holding blocks or jaws. The teeth at *A* and *B* are milled with formed cutters, as on the pipe wrenches.

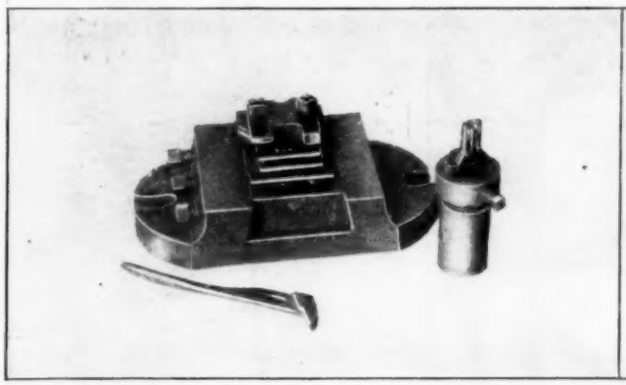


FIG. 11. PUNCH AND DIE FOR SMALL SHIFTING HOLES

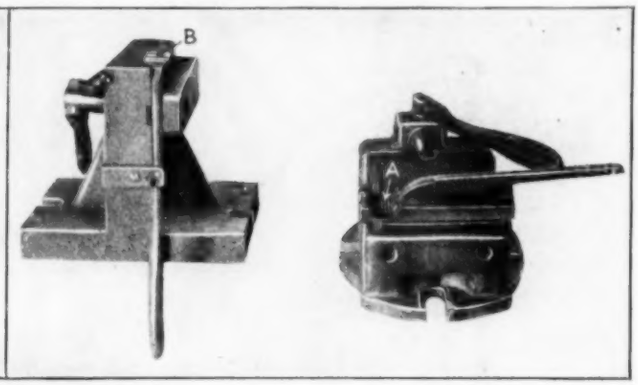


FIG. 12. JAW-TOOTH MILLING JIGS

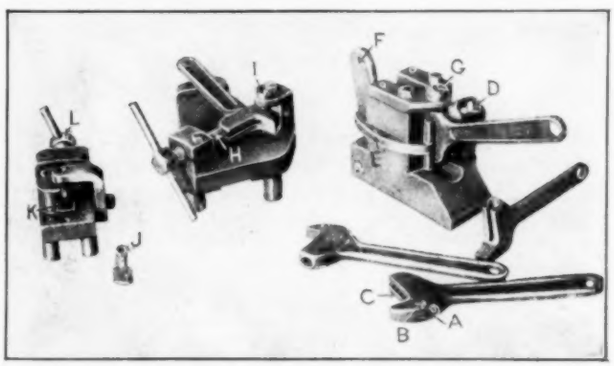


FIG. 13. END WRENCH JIGS

Adjustable end-wrench body forgings are first milled across the ends for the jaws, then a hole *A*, Fig. 13, is drilled through for the adjusting screw. The retaining-pin hole *B* is drilled, and next a slot is sawed out at *C*. The first milling operation is an ordinary one, so need not be shown. The screw hole is drilled in the jig seen at the right. The forging is located in the jig by thrusting the milled surface against a block and tightening the setscrew *D*. Side motion is prevented by a wedge clamp *E* operated by the wedge lever *F*. The hole is then drilled down through the bushing *G*.

The retaining-pin hole is drilled in the middle jig. The forging is located between a stationary pin and an adjustable clamping pin *H*, and the hole is drilled through the bushing *I*.

The movable jaw for the end wrench has a hole *J* drilled in it which is done in the jig at the left. The piece is held in the jig in formed jaws *K*, which are pivoted near the middle; and the work is held by the wedging and spreading action of the pointed screw *L* at the back.

Sawing Out the Slot

The slot in which the movable jaw slides is cut out in a special machine, Fig. 14, made by the Mechanics Machine Co. The forging is held in practically the same way as in the screw-hole drilling jig. The setscrew is carried in a yoke *A*, and the wedging lever operating the side-clamping jaws is shown at *B*. The slot is cut with the saw *C*, which is worked by means of a crank motion. Feed is obtained through levers and a weight *D*, to which a spring is also attached. Means are provided for automatically stopping the machine at the proper depth of cut. When removing or inserting work, the saw is held up out of the

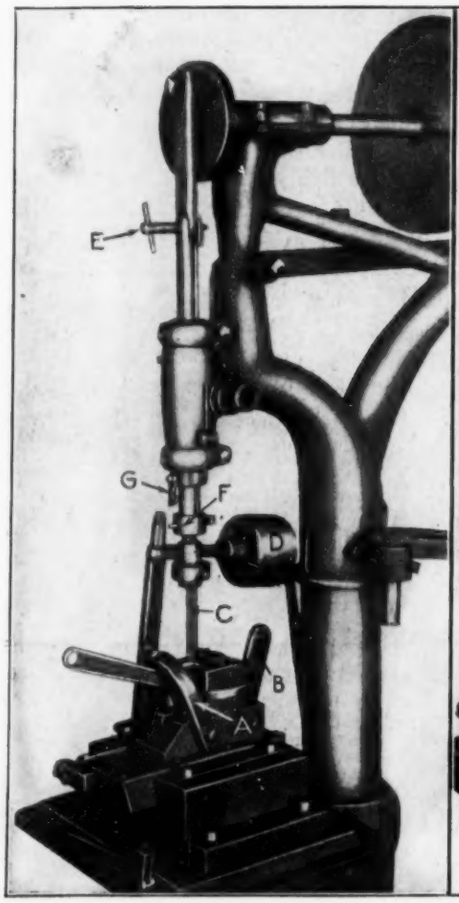


FIG. 14. SLOT-SAWING MACHINE

FIG. 15. MACHINE EMPTY

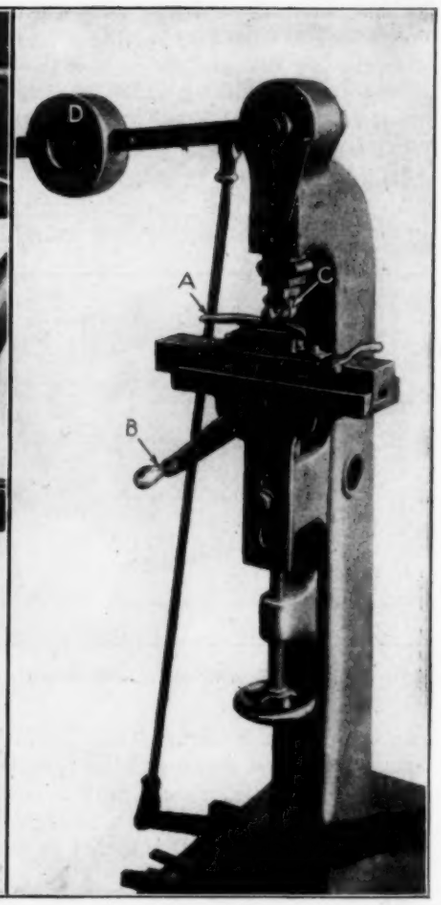


FIG. 16. LETTERING MACHINE

way by first pulling out the pin *E* and then catching the spindle pin *F* in latch *G*. The machine with the work removed and the spindle locked in the upward position, as described, is illustrated in Fig. 15.

Names are rolled into wrench forgings in the machine seen in Fig. 16, which was also made by the Mechanics Machine Co. The forging is placed at *A* and the lettering rolled in by turning the crank *B*, which causes the table to move and traverse the work under the lettering roll *C*. The right pressure to obtain even lettering is obtained by the lever and weight *D*, which may be adjusted to suit the work in hand. The weight and roll are lifted to clear the work by depressing the foot treadle.

Teaching the Munition-Making Trades as a War Measure

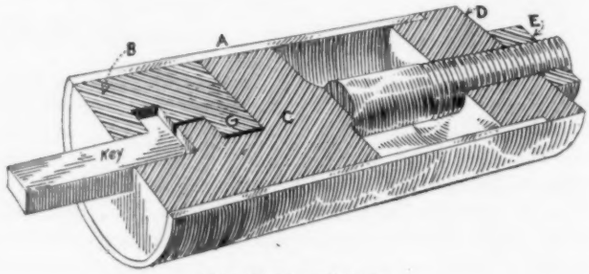
Interesting reports of the effects of the war on English shops and English workmen include the forming of classes for training workers in munition factories. These, it is understood, are being conducted by the London County Council and other similar bodies in various manufacturing centers and at the request of the Ministry of Munitions. The instruction is given to both machine operators and tool setters, the former predominating, as would be expected. Various branches of the trade are taught, including general machine work, such as is found on shells and fuses; lead burning, which is almost a lost art in some sections; and tool setting, as distinguished from machine operation.

Women are also being trained in some trades. Many seem to be taking up the occupation of tracing in drafting rooms and are said to be making marked progress.

A Gib-Key Puller

By J. A. Moffat

A gib-key puller is shown in the illustration. It consists of a sleeve *A*, made from iron pipe; a member *B*, which holds the key; and the puller *C*, with a tongue *G* which engages *B*. The washer *D* rests on one end of the



GIB-KEY PULLER

sleeve *A*. The other end of the sleeve rests on the hub of the pulley. When the nut *E* is screwed down, the key puller and the key are drawn through the sleeve. For handling different sizes of keys the member *B* is the only part that need be changed.

Enlarging the Small Shop Through Special Policies

By John H. Van Deventer

SYNOPSIS—The "special-machinery" shop is heavily handicapped as compared with shops that work upon a definite product. This article tells of the special policies that have enlarged a New England special-machinery shop from 7-man size to 100-man size within the space of four years. These policies may well be adopted by other special-machinery shops anxious to build upon a solid foundation.

A special-machinery company has nothing tangible to sell except labor, the use of its tools, and the ability to construct machinery in accordance with the specifications

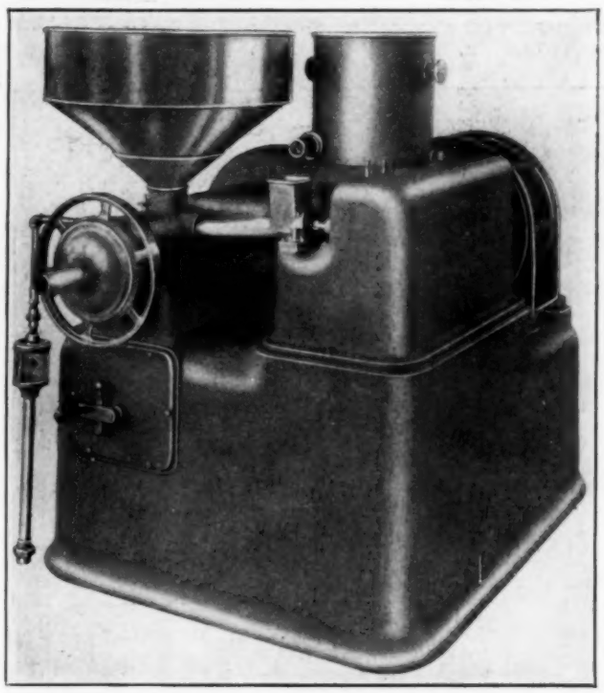


FIG. 1. MACHINE FOR MAKING PEANUT BUTTER

of its customers. It can seldom show a man what he is going to get for his money, nor can it often predict the cost of the thing to be made. Consequently the small special-machinery shop has a hard row to hoe and needs a fertilizer in the shape of some good definite policies that will enable the shop to grow and the profits to blossom forth.

The shop that I am going to describe has had some very definite policies ever since its establishment; not as theories only, but embodied in hard iron and steel. That they have been profit-producing policies is evidenced by the 100 men now employed as compared with the seven men employed four years ago. Not the spasmodic growth accompanying unusual conditions is this, for the plant and equipment have grown as fast as the number of men; in fact today one would find in this plant a higher percentage of machine tools per man than in the original seven-man shop.

The materials used in building shops are considerable in number, among them being structural steel, concrete, stone and glass. But even more varied are the materials upon which shops are sometimes built. This one—the Hartford Special Machinery Co., of Hartford, Conn.—may be said to have been partly built upon peanut butter and bacon. Previous to starting this shop, Joseph Merritt was a special machine designer and among his principal products had been machines for the Beechnut Packing Co., one of which is shown in Fig. 1. This is a special machine that turns out peanut butter from hulled nuts as raw material, at the rate of some 11 tons per day, and is an example of well-executed safety engineering, its working parts being guarded in such a manner as to make it impossible for the girl operator to be hurt.

That a shop partly founded upon peanut butter and bacon should in its younger days be nourished by the fragrant odors of good cooking is rather a coincidence. On investigation of Hartford manufacturing history however, a very good precedent is found for this. The Dwight-Slate Co., the Woodward & Rogers Co., the Pratt & Whitney Co., and the Fenn Machine Co. (afterward Taylor-Fenn Co.) all made their initial start in this same loft over Harry Bond's restaurant. Perhaps good cooking may have something to do with the growth of a shop as well as with the growth of a man! At any rate, Mr. Merritt selected this same loft building with its encouraging precedents as a place in which to make his start. The first purpose in starting it at all was to build machinery of his own design under his own direction. However, this idea of exclusiveness was abandoned shortly afterward and the shop began to turn out special machines of other design also.

One of the first policies established in this special-machinery-building plant had to do with the employment of high-grade operators. A $6,000 tool and a $6-a-week boy do not get along well together. The boy is likely to be spoiled, and the machine is sure to be. A special-machinery-building shop with its great variety of work does not have an opportunity to train specialists such as are found in a manufacturing shop. Its need is for all-around men, and good all-around men are high-priced. Every machine-shop manager knows that the difference in established rates of pay between a "cheap" man and a "good" man is nowhere in proportion to their difference in skill. It is therefore to the customer's advantage to go where skilled and high-rated men are employed, for although he pays a higher rate per hour he secures a big increase of skill at a small increase of rate as compared with the ordinary shop. The contents of hours may vary as much as the contents of paper boxes of the same size!

The cost of an experimental machine is the least important thing about it, in spite of the contrary opinion of many who buy them. As a rule machines of this kind are outside of standard machine competition, and hence their earning ability is sometimes phenomenal. This is particularly true of the cases in which special machines

are built to combine a number of operations. A half-day's shutdown on a machine of this kind is sometimes more expensive than the original cost of the machine itself. Many special-machinery-building shops are obliged to resort to daily makeshifts, which tax the ingenuity of the men employed, in order to rig machines up for operations that are not suited to them. Ingenuity of this kind is depicted every week in the pages of the *American Machinist;* but these admirable and interesting stunts do not benefit the customer who is paying for work by the hour. In this shop the attempt is made to have a suitable tool for each operation, so that the use of makeshifts may be practically eliminated. In line with this, when a machine is purchased, all of the special attachments and fixtures listed for it are also usually bought, even though there may be no immediate prospect of their use. This policy runs up the investment in machinery and equipment to a figure that would alarm owners of a good many plants of similar size, but it has been proved to be a profitable policy in this case. On the larger tools the policy established has been to buy machines that are oversize in one or more particulars. This gives a degree of flexibility that would not be obtained in a similar shop equipped with standard tools. A horizontal boring machine, for example, has a column one foot higher and a bed two feet longer than standard for this size of machine. This saves the use of makeshifts on work that would otherwise be just a little too big for the standard machine. An apt comparison of this policy might be that between two motor truck

FIG. 2. THE LARGE NUMBER OF LATHES EMPHASIZES THE IMPORTANCE OF THIS TOOL FOR GENERAL WORK

FIG. 3. THE TOOLROOM PRESENTS AN EXAMPLE OF CAREFULLY PLANNED STORAGE FACILITIES

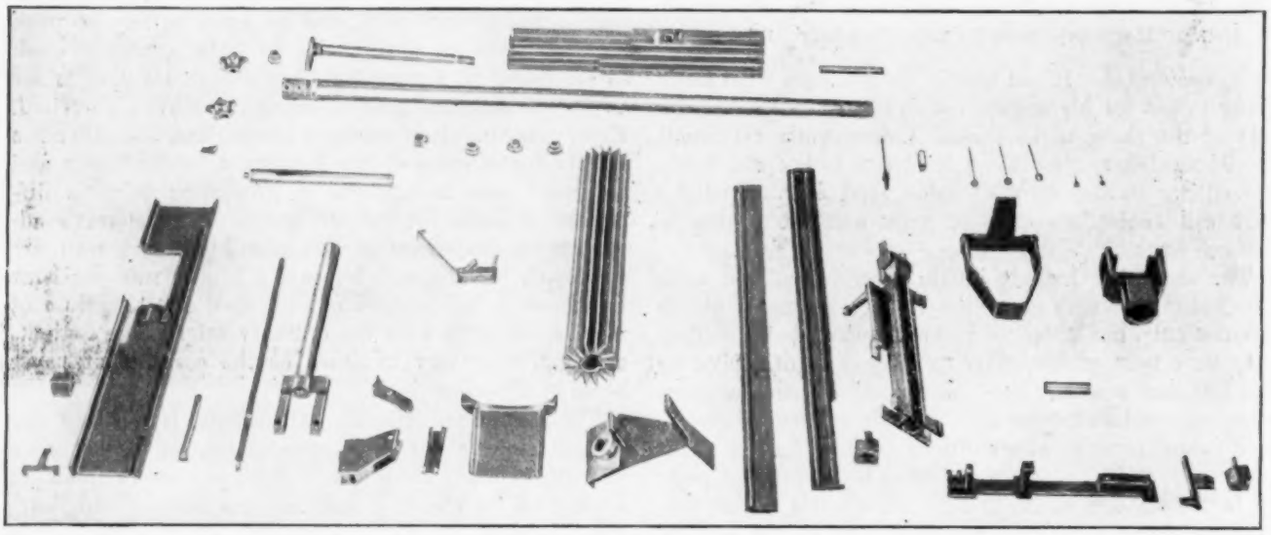


FIG. 4. AUTOMATIC RIFLE PARTS, MOST OF THEM MILLED FROM SOLID STOCK

owners, each having the same size truck, but one of which has a truck body twice as large as the other. Each truck can carry the same load of some heavy material, such as pig iron, but when it comes to transporting light, bulky material, the fellow with the oversized body has the bulge on his competitor.

Buyers of special machinery may be broadly divided into two classes—those who know what they want, and those who don't. Strange to say, the latter class is often the more satisfactory to work for! One who has been through the mill in building experimental machines makes a good customer for the special-machinery-building shop, for he knows the difficulties encountered in making the first workable machine of a new kind. He does not expect to get the first machine as cheaply as the second or third, and is prepared to make allowances for a high

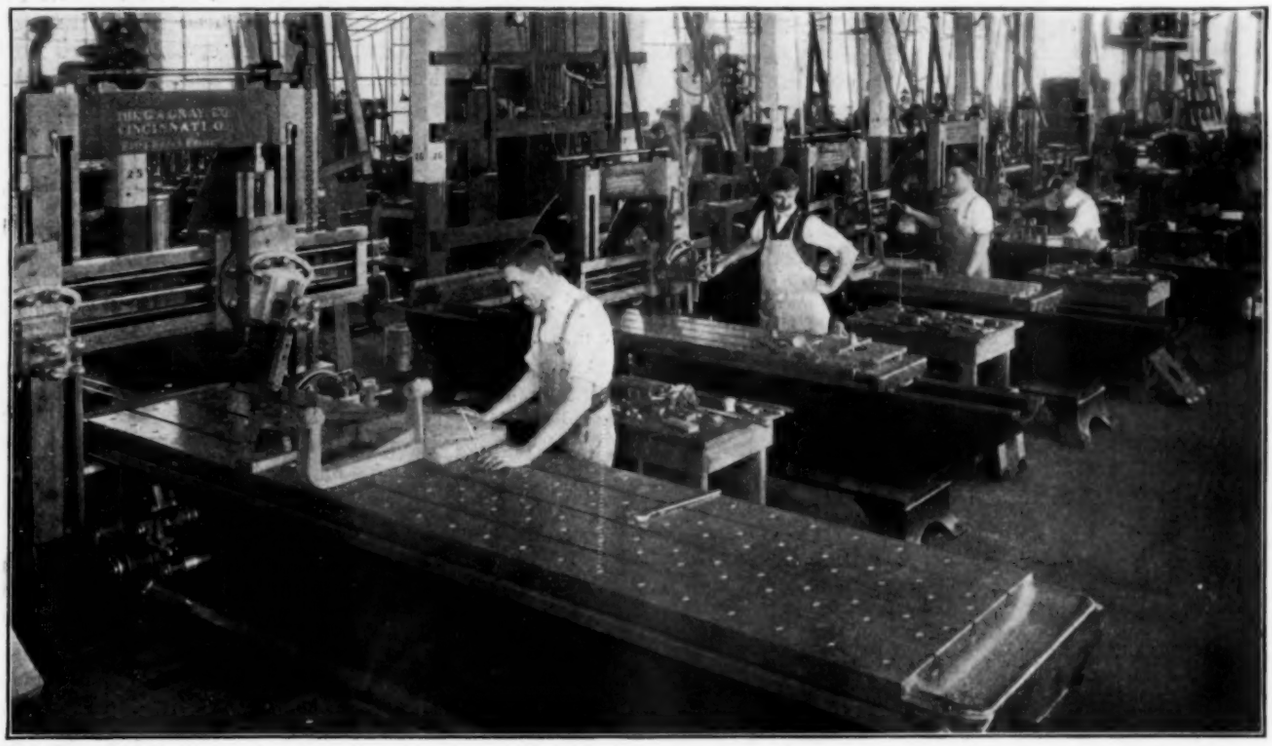


FIG. 5. NOTE THE UNBLEMISHED PLATENS AND THE TOOL TABLES

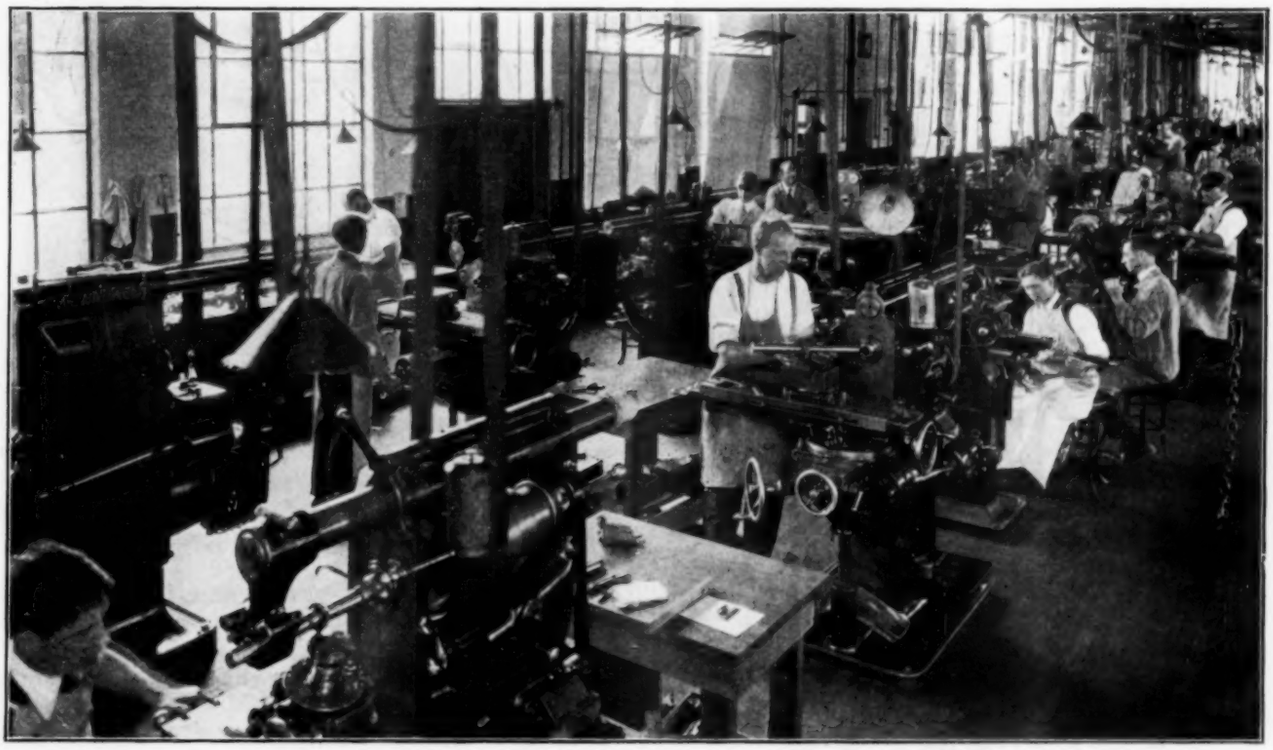


FIG. 6. THE CONDITION OF THE MACHINES REFLECTS THE CARE OF HIGH-GRADE OPERATORS

first cost. Those who are not so prepared do an injustice to special-machinery-building shops. Some of them after having the first machine built take the second one to

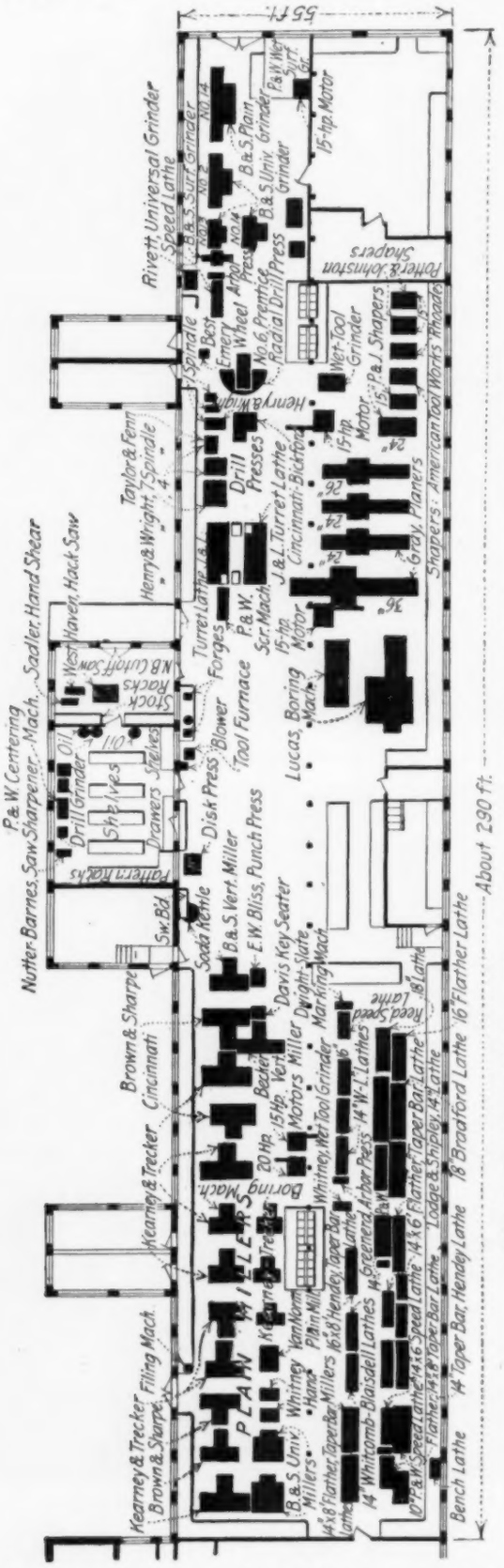


FIG. 7. PLANT LAYOUT DESIGNED TO BE ESPECIALLY ADAPTED FOR CONTRACT SHOP

another shop and then make unkind remarks about the amount that the first shop charged them. They forget that it is far more difficult to transform paper plans into a workable first machine than it is to build an improved model of a machine that already works.

The policies outlined and applied in this Hartford shop are worthy of study and imitation by other special-machinery-building plants. They all crystallize into one machine-building axiom: Experienced men with tools suitable for the job will give the customer more work and better service than inefficient men with unsuitable tools.

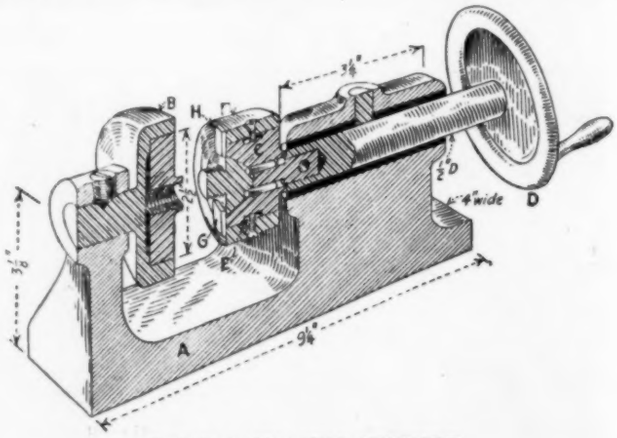
Hand-Driven Thread-Chasing Fixture for Detonator

By J. J. Eyre

A simple device for sizing threads on small parts for quantity production is shown in the illustration. The fixture was fitted for sizing the thread on caps for a detonator body, but can be adapted to other lines with good results.

The body *A* of the fixture is bored in line to receive the die holder *B* and the driving shaft for the work holder *C*, to which is attached the handwheel *D*. The die holder is bored a little large to hold the standard die to be used, drilled and tapped for three headless screws that retain the die, and the screws should be adjusted to allow for float of die.

The work holder, or chuck for the work, required a special construction, owing to the crowning surface of the work. The chuck was turned down for a shank to



THREAD-CHASING FIXTURE

fit in the shaft that rotates it and is bored out so that the work will seat flush with the face of the chuck. Two holes are bored in the seat of the chuck in line with the wrench holes in the work, and pieces of drill rod are inserted, projecting above the surface of the chuck to act as drivers for the work.

The outside diameter of the chuck is turned $\frac{1}{8}$ in. off center and a groove turned to receive the spring band *E* that secures the shell *F* in place. Two $\frac{1}{16}$-in. holes are drilled in the face of the chuck for riveting on a $\frac{1}{16}$-in. plate, or sector, *G* that forms a ledge on the chuck to act as a seat when inserting work. This plate should be located directly opposite the eccentric center of the outside diameter.

The shell *F* is bored out to a slip fit over the body, knurled on the outside for hand control, and is drilled to rivet to the band *E* after it is sprung over the body and into the groove. Two holes are drilled in the front face of

the shell for riveting on the work-retaining plate, which is a short sector *H*, $\frac{1}{16}$ in. thick, that projects on the inside diameter over the surface of the work. The shell can be quickly turned by hand so that the projecting edge of the sector will instantly release or lock the work in place, owing to the outside ring or shell being eccentric with the work center.

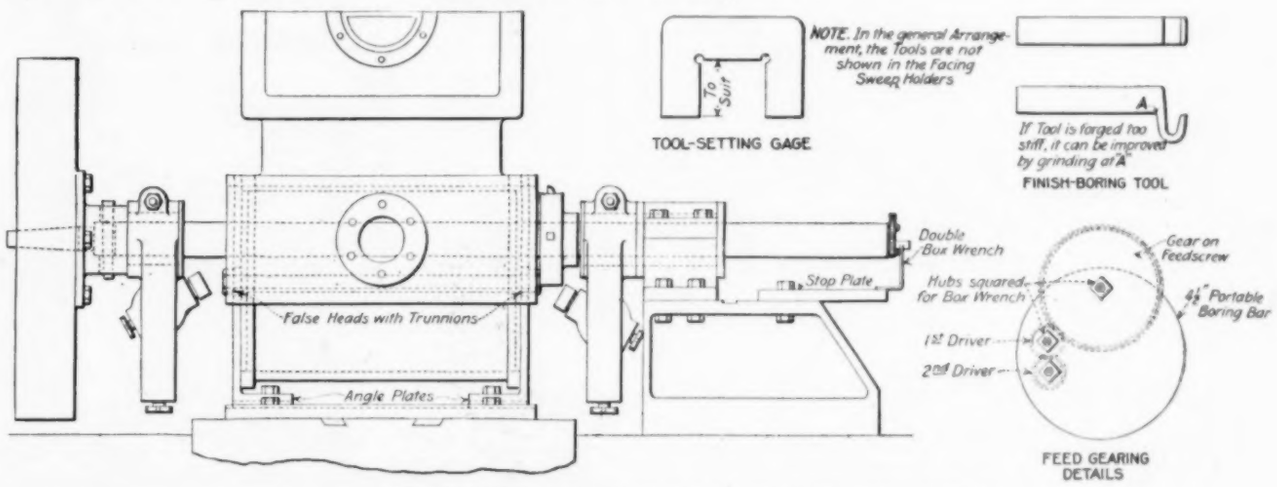
The hole for the shaft can be bushed, an oiler added and a compression spring placed over the shaft between the handwheel and the bearing for the shaft for the return of the chuck; if desired.

Locomotive Valve Chambers Bored on Engine Lathe

By Roland V. Hutchinson

The use of the lathe as a boring machine is by many looked upon as a makeshift; but the instance herewith described will be of interest, as the output of a special cylinder-boring machine on similar work was equaled.

The job was a number of large locomotive cylinders for freight engines and was handled by the Ironton Engine Co., Ironton, Ohio, which made the castings, bored and faced the cylinder and valve chests, tested the castings to 250-lb. cold-water pressure and shipped the castings to the customer, who completed the machining himself.


NOTE. In the general Arrangement, the Tools are not shown in the Facing Sweep Holders
To Suit
TOOL-SETTING GAGE
A
If Tool is forged too stiff, it can be improved by grinding at A
FINISH-BORING TOOL
Double Box Wrench
Stop Plate
False Heads with Trunnions
Angle Plates
Gear on Feedscrew
Hubs squared for Box Wrench
4½" Portable Boring Bar
1st Driver
2nd Driver
FEED GEARING DETAILS

BORING AND FACING LOCOMOTIVE VALVE CHAMBER IN A LATHE

Early delivery had been promised, and the Barrett cylinder-boring machine was tied up with the work on the barrels, so recourse was had to a 48-in. Schumacher & Boye lathe for boring out the valve chambers. It was rigged up as shown in the drawing.

A driving plate centered by a plug in the lathe spindle was bolted to the large faceplate. This plate was bored out to fit the 4½-in. portable boring bar and turned on the outside to fit the facing arms, or sweeps, which were made duplicates of those on the Barrett machine. The upper part of the tailstock was removed, and in its place a bearing was bolted and doweled. This bearing carried a sleeve, holding the other facing arm, and the sleeve was driven by a feather key.

To hold the cylinders, a large cast-iron plate was planed up on each side and a groove cut in one side. This plate was bolted to the carriage. Two angle plates, fitted with keys, had holes bored in them for the hubs of the false heads to fit in. Each false head was lightly fastened to its respective angle plate by two ¾-in. capscrews, and a long bolt was passed through the middle of each false head, holding it securely in place on the cylinder.

The feeding arrangement was originally a star feed, but was changed to give two speeds to the feed screw and a reverse. Each gear shown has a square hub and a socket wrench with a bent handle, slipped upon the hub of the gear that is required to give a feed in each direction of $\frac{1}{16}$ in. per revolution, or ¼ in. per revolution in only one direction. The feed screw is ¼ in. pitch. The wrench was made with a long socket, so that it could be turned around and used for easily adjusting the head by hand.

To bore a valve chamber, the tailstock is run back along the lathe bed, carrying the bar with it. The false heads and angle plates are secured in the cylinder barrel and the casting lifted upon the lathe. The keys in the angle plates fit the slot in the plate, and screw-jacks under the valve chamber enable the casting to be swung on the false heads so as to clean up true with the layout. The tailstock is run forward, the boring bar entered in the driving casting and pulled up tight against an internal shoulder by the draw-key that accomplishes the driving.

When the job is clamped, roughing tools are set in the boring head to a gage, as shown, and rough-boring and facing each end take place. The head was turned exactly 12 in. in diameter, so that the making of tool-setting gages presented no difficulty. The type of finishing tool shown has been successfully used on both horizontal and vertical boring machines for finishing cylinders, valve bushings, etc. It does away with the unlovely "washboard finish" that has a tendency to intrude where it is not wanted, when an ordinary broad-nose tool is used. Grinding in the corner indicated will "limber up" this type of tool so that it will soon work well.

Although apparently working under handicaps, this arrangement enabled the valve chambers to be machined at the same rate as that at which similar work had been done on the cylinder-boring machine; in addition, there were duplicate parts for the special machine, should accident make it necessary ever to have a new facing arm and part in a hurry.

Tools Used in Machining Textile Machine Parts

By Robert Mawson

SYNOPSIS—In this article are illustrated some of the jigs and fixtures used in machining parts of hosiery machines. The fixture employed in milling the dropper post is arranged to hold eight parts at one operation. A fixture having an adjustable stop mills the angular surfaces on the dropper. For milling the bed plate the correct location is obtained by a pin fitted into a hole previously drilled in the part. The jigs are provided with latch covers and each part is quickly and accurately placed in the tool.

Some of the tools used by Scott & Williams, Inc., Laconia, N.H., were shown on pages 1020 (Vol. 44) and 10. In this article are illustrated other tools which consist of jigs and fixtures used in machining other elements.

For milling the slot in the bed plate the fixture consists of a plug on which the casting is placed. A knurled-head pin is fitted into a machined hole in the bed plate and into a hole in the fixture. By this method the surface machine is in the correct location with the holes. The jig employed in drilling the bed plates has a turned plug which fits into the large bored hole in the casting. The location is obtained by a surface against which the part is revolved. The milling fixture used for the dropper posts machines a number at one time, the rough casting being located by pins. The parts being machined are held in position by straps.

A graduated fixture is used for machining the angular surfaces on the droppers. The part is held by a strap, the round shank fitting into a concave surface.

The two positions at which the fixture is placed are determined by adjustable screws provided with check nuts.

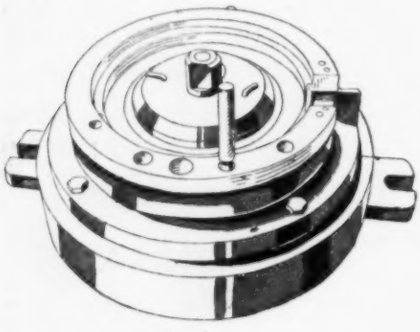


FIG. 2

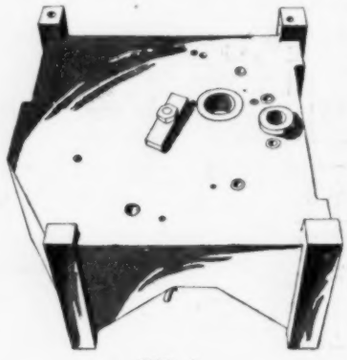


FIG. 3

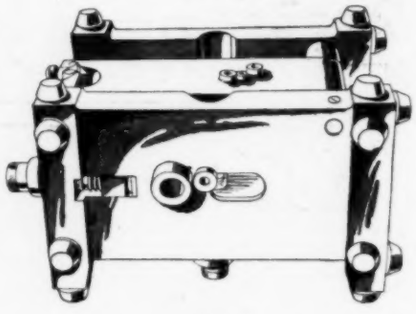


FIG. 6

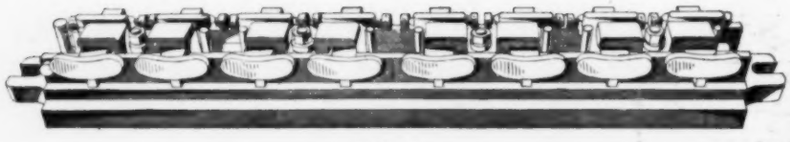


FIG. 5

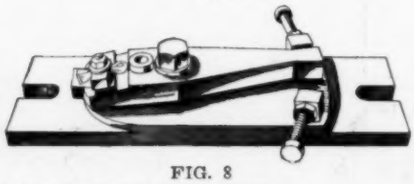


FIG. 8

TOOLS USED IN MACHINING TEXTILE-MACHINE PARTS, WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operation—Milling the slot in the bed plate, Fig. 1. The casting is placed on a plug which fits into a bored hole. A knurled-head pin is then slid through a hole in the casting into another hole in the fixture.

Surface Machined—The slot using a 1⅞x5-in. diameter cutter operating at 140 r.p.m.

FIGS. 3 AND 3-A

Operation—Drilling and reaming the bed plate, Fig. 1. The casting is located on a plug which fits into the large center hole previously bored. The casting is slid around until the edge of the slot comes in contact with a stop surface. The cover is then dropped down and latched. Afterward knob-headed screws, being tightened on the casting, hold it securely in the jig.

Holes Machined—One ⅛ in. drilled, three ⅜-in. spot-drilled and reamed, one ⅛-in. drilled, two No. 6 drilled, two No. 13 drilled, four No. 19 drilled, one ½-in. spot-drilled and reamed.

FIGS. 5 AND 5-A

Operation—Milling surfaces on dropper post, Fig. 4. The rough casting is located against pins resting on a height block. The various clamps are then tightened down, thus holding the eight castings in position on the fixture.

Surfaces Machined—Ends of casting and pad. The gang cutters used consist of two 6-in. diameter by ¾-in. wide and one 2½-in. diameter by ⅜-in. wide, operating at 100 r.p.m.

FIGS. 6 AND 6-A

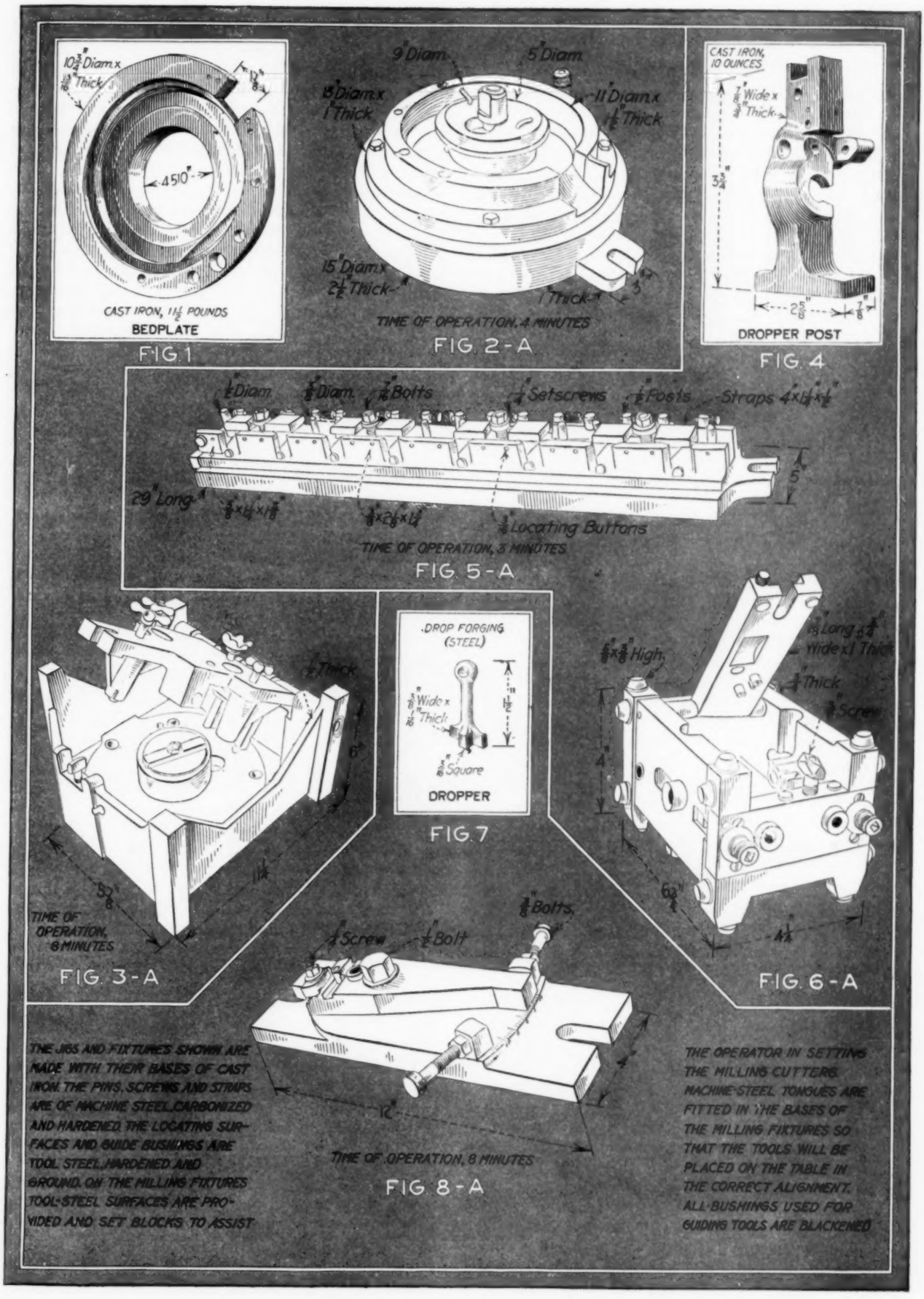
Operation—Drilling and reaming dropper post, Fig. 4. The milled casting is located against stop-pins being forced back by setscrews. The casting is held down by hook bolts operated at the end and under the jig. The cover is then dropped down and held with a thumbscrew.

Holes Machined—Two 17/64-in. drilled, one 27/64-in. drilled, one 7/16-in. spot-drilled and reamed, one No. 32 drilled, three No. 20 drilled, one No. 47 drilled, one No. 28 drilled and one ⅜-in. spot-drilled and reamed.

FIGS. 8 AND 8-A

Operation—Milling dropper, Fig. 7. The steel-forged element is placed in a machined groove in the fixture and held with the strap and nut as shown. The revolving member of the fixture is swung around against one stop-screw and the angular surface machined. The member is then swung against the other stop and the other surface machined.

Surface Machined—The two angular surfaces at the outer end of the dropper. For this purpose a ⅜-in. end mill operating at 250 r.p.m. is used.


10¾" Diam. x 1⅛" Thick
4.510"
CAST IRON, 11½ POUNDS
BEDPLATE
FIG. 1
9" Diam.
5" Diam.
13" Diam. x 1" Thick
11" Diam. x 1½" Thick
15" Diam. x 2½" Thick
1" Thick
TIME OF OPERATION, 4 MINUTES
FIG. 2-A
CAST IRON, 10 OUNCES
⅞" Wide x ¾" Thick
3¾"
2⅝"
⅞"
DROPPER POST
FIG. 4
½" Diam.
⅜" Diam.
⅜" Bolts
¼" Setscrews
½" Posts
Straps 4" x 1½" x ½"
29" Long
⅜" x 1½" x 1⅛"
⅜" x 2⅛" x 1½"
⅜" Locating Buttons
5"
TIME OF OPERATION, 3 MINUTES
FIG. 5-A
½" Thick
6"
5⅜"
11¼"
TIME OF OPERATION, 8 MINUTES
FIG. 3-A
DROP FORGING (STEEL)
⅜" Wide x ⅛" Thick
1½"
⅜" Square
DROPPER
FIG. 7
⅝" x ⅝" High
1⅝" Long x ¾" Wide x 1" Thick
½" Thick
½" Screw
4"
6¾"
4½"
FIG. 6-A
⅜" Bolts
¼" Screw
½" Bolt
12"
4"
TIME OF OPERATION, 8 MINUTES
FIG. 8-A
THE JIGS AND FIXTURES SHOWN ARE MADE WITH THEIR BASES OF CAST IRON. THE PINS, SCREWS AND STRAPS ARE OF MACHINE STEEL, CARBONIZED AND HARDENED. THE LOCATING SURFACES AND GUIDE BUSHINGS ARE TOOL STEEL, HARDENED AND GROUND. ON THE MILLING FIXTURES TOOL-STEEL SURFACES ARE PROVIDED AND SET BLOCKS TO ASSIST
THE OPERATOR IN SETTING THE MILLING CUTTERS. MACHINE-STEEL TONGUES ARE FITTED IN THE BASES OF THE MILLING FIXTURES SO THAT THE TOOLS WILL BE PLACED ON THE TABLE IN THE CORRECT ALIGNMENT. ALL BUSHINGS USED FOR GUIDING TOOLS ARE BLACKENED

DETAILS OF JIGS AND FIXTURES USED IN MACHINING TEXTILE-MACHINE PARTS

High-Speed Steel Collapsing Taps for Iron Fittings

By A. J. Chamberlain

High-speed steel collapsing taps are rapidly replacing solid taps in the manufacture of pipe fittings, although much difficulty has been experienced with some of the taps that have been on the market. The continuous tapping of rough-cored holes in gray and malleable iron fittings calls for greater rigidity and better wearing qualities than most collapsing taps possess, particularly when made in small sizes. It is a comparatively easy matter to construct a rigid small-opening die, for the designer can make the die head of a size large enough to allow generous proportions to the different parts of the opening mechanism; but the mechanism of a small collapsing tap is generally jammed into the small body of the tap, necessitating the use of small parts that are too frail to stand the strains in a pipe-fitting tapping machine.

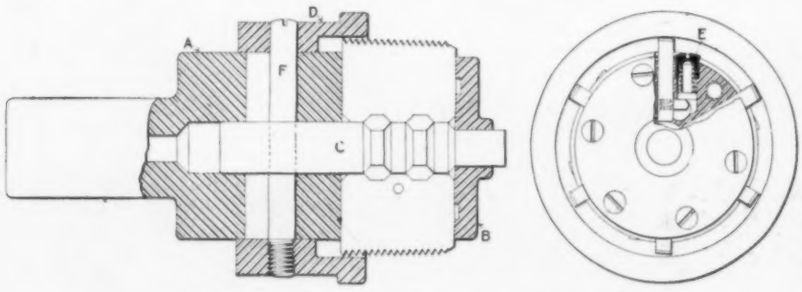


FIG. 1. TAP FOR LARGE-SIZED PIPES

When one considers the enormous strain that the mechanism must operate under and the amount of metal that a collapsing tap must remove in a day's run on an automatic tapping machine, the necessity of rigid fool-proof construction and generous wearing surfaces in the mechanism of these tools is readily realized. In the pipe-fitting business it is generally known that most small-sized collapsing taps, although sometimes recommended for this purpose, are not always successful, for the cost of maintenance and renewals and the lost time in breakdowns are often greater than the increase in production will warrant. Perhaps the most rigid small-sized taps are those designed with roller-type cutters, in which the cutters are made of round steel and the closing action is obtained by revolving them until the cutting teeth will clear the threads. This form of tap is adjusted for size by varying the cutting position of these roller cutters. Although mechanically incorrect, because adjustment changes the rake and clearance of the cutting teeth, these taps are widely used and the adjustment seems to answer the purpose for most work.

The tap shown in Fig. 1 was designed to be made in the larger sizes only—from 2½-in. pipe size up—and was quite satisfactory, as it seemed to stand up much better than others that had been used. It is very rigid, its cutters contain less high-speed steel than the roller-type taps, and it is easily made. The body *A* is of hardened high-speed steel, and the end bearing *B* is tongued into the body, as shown, and held to it with fillister-head screws.

The opening plug *C* should be made of hardened high-speed steel, as there is considerable pressure upon it when it slides back during the closing action—enough to cause a carbon-steel plug to wear. The closing collar *D* should be hardened on its face, which comes against the face of the fitting being tapped. The plug *C* is thereby caused to slide back into the body until its surfaces that contact with the bottom of the tap cutters are in line with the cutter grooves, when the springs *E* force the cutters down into the grooves of the plug, thereby closing the tap. The tap is then run back against a fixed stop on the machine, which comes in contact with the back face of the closing collar and forces the plug back to the opening position shown. Adjustment is obtained on taper taps by placing the screw *F* in the different holes provided in the closing collar. This tap, if made in sizes from 2½ in. pipe up, will bear hard usage; but as is readily apparent, its parts would have to be too frail to stand up if it were made smaller.

In this article the tapping of common iron-pipe fittings in rough-cored holes has been referred to. It is an altogether different proposition from the ordinary bar-stock work on a screw machine or the better grade of turret-lathe work. A tap on a screw machine or turret lathe generally has a rest at regular intervals while the remainder of the operation is performed, but on a pipe-fitting tapping machine the operation consists of tapping rough-cored holes in enormous quantities, with perhaps only a slight shift in one lot of cored holes, but more shift in the next. On brass goods I have used collapsing taps as small as ¾-in. pipe size.

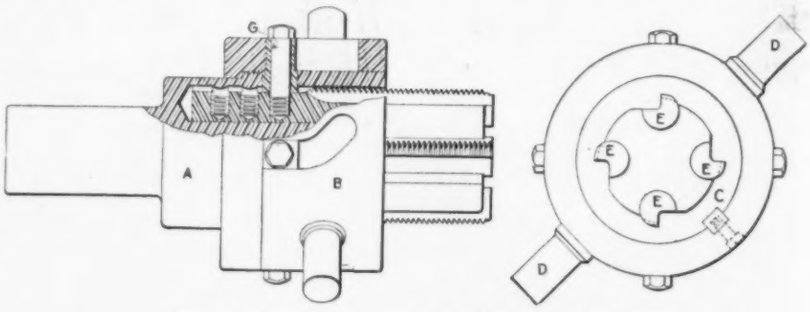


FIG. 2. TAP FOR SMALLER SIZES OF PIPES

The roller-type tap, Fig. 2, is designed to be made in pipe sizes above 1¼ in. The body *A* is of low-grade tool steel hardened on its working end. *B* is the sliding cam collar, which has a cam slot milled on it for each cutter in the tap and a keyway with small holes in it to admit the doweled key *C*. It also has two tapped holes for the stop pins *D*. The cutters *E* are made of round stock, and three tapped holes are provided to allow advancing them when ground off on their cutting ends by sharpening. They also have a keyway milled across these holes, to admit the solid keys that are machined on the hardened cam pins *G*. These cam pins are held to the cutters by hardened hexagon-head screws.

Some Foundry Practice in a Connecticut Plant

By Frank A. Stanley

SYNOPSIS—Castings and foundry methods in making lathe and cistern-pump parts. Machine molding is shown on a pump cylinder. Transporting methods are also illustrated.

The machine-shop practice of W. & B. Douglas Co., Middletown, Conn., will be shown in a later article in these columns. The purpose of the present article is to show some lines of apparatus manufactured by the same concern and to illustrate in connection therewith some of the foundry methods and equipment for preparing the cast parts for machining.

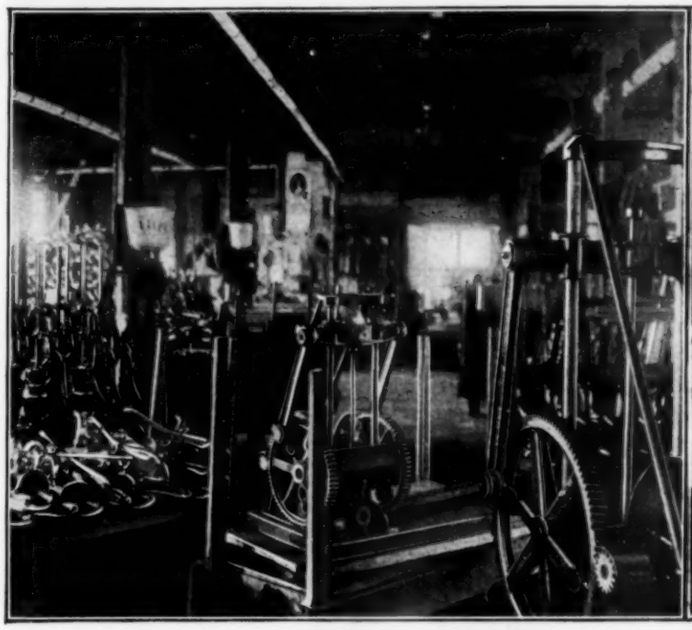


FIG. 1. PUMPS IN STOREHOUSE

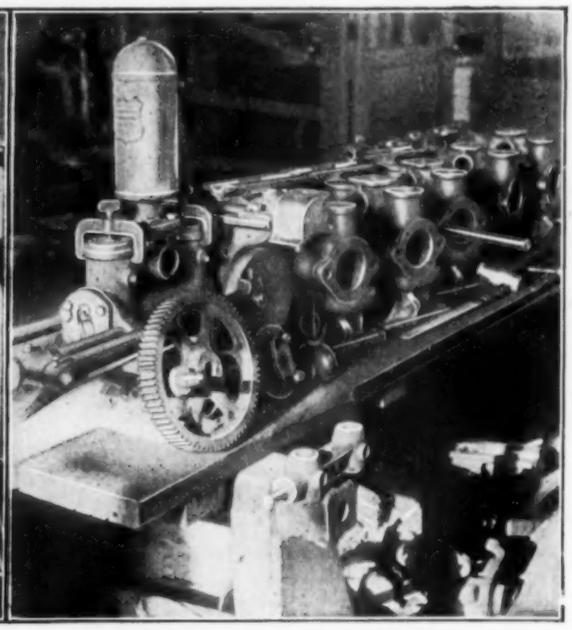


FIG. 2. PUMPS UNDER ASSEMBLY

As is well known, there is no great amount of machine work on ordinary pumps, particularly on the hand or household type, commonly called the cistern pump. The principal job on this is to bore out the cylinder, an operation that is usually performed by some special machine that bores several cylinders simultaneously.

In such a plant, therefore, the importance of foundry operations relative to machine-shop work is proportionately increased as the amount of machine work required decreases. The tendency is to expect more and more from the foundry in the way of producing castings that, if they require few shop operations, such as boring, turning, facing, etc., at the same time need little in the way of cleaning up with emery wheel, chisel or file to make them presentable after they have been painted. It is not an uncommon experience to find that the cost of putting small and medium-sized castings into shape, clearing off fins, ugly burrs, smoothing up the irregular bosses and the like, forms a big percentage of the total cost of the castings when ready for assembling in the finished machine.

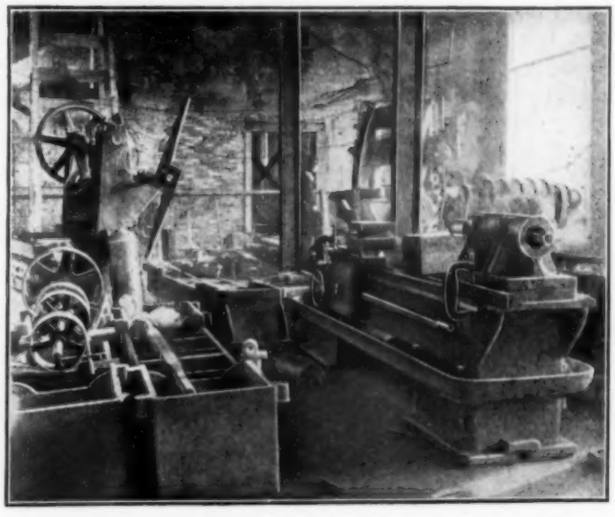


FIG. 3. LATHE UNDER ERECTION; PUMP IN BACKGROUND

Although labor in this line of work is not highly paid, as compared with the skilled trades in the foundry and shop, it is nevertheless an important factor in determining total items of expense, and such hand processes as chipping, filing and grinding should be eliminated as far as possible by improved facilities in the foundry or by careful and complete utilization of such facilities and equipment as are now present.

In the Douglas pump factory an endless number of castings of all kinds—handles, barrels, cylinders, stuffing-boxes, bases, joints and connections—are produced in the foundry. Without attempting to indicate directly even a small percentage of the output, it may

be well to call attention to the different finished pumps shown in the stockroom, Fig. 1, and to the bench loaded with pump parts, Fig. 2. These are shown merely to give some hint of the variety of material handled in the foundry and factory of the Douglas company.

ating the pumping apparatus for all kinds of wells, and these may be driven by gasoline, oil or steam engines, electric motors or lineshafts.

Fig. 2 shows a somewhat different line of pump work, the castings on the bench in this view being for a set

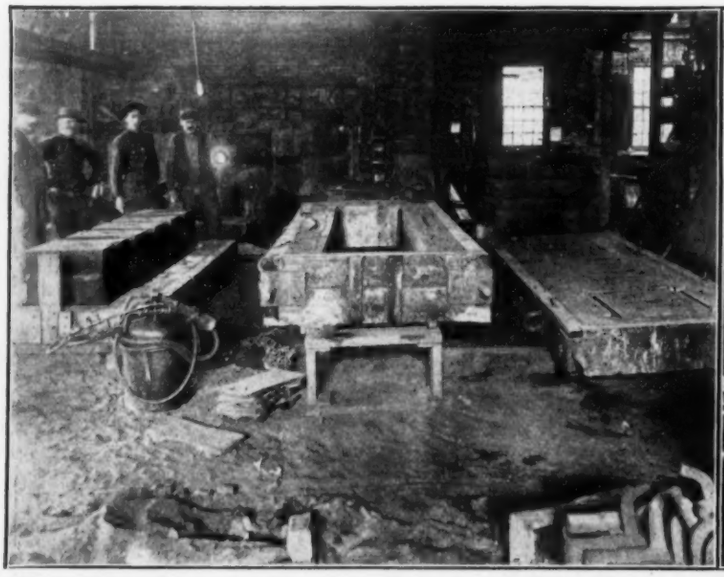


FIG. 4. MOLD FOR HEAVY LATHE BED WITH CORES SHOWN TO THE LEFT

FIG. 5. TROLLEY SYSTEM FOR HANDLING LADLES ABOUT THE FOUNDRY

FIG. 6. MACHINE MOLDING OF PUMP PARTS

The hand pumps, at the left in Fig. 1, are made in many styles and in tremendous numbers. The larger machine, in the middle and right foreground, are what are commonly called deep-well working heads for operof 3x5-in. pumps, for either hand or power operation; that is, while these pumps may be normally used under power, there are occasionally times when it is desirable to be able to operate them by hand, as when current

may be cut off, gasoline exhausted or steam power shut down. In such cases the hand lever may be applied and the pump worked satisfactorily during such period as may be necessary until the resumption of the supply of power.

The boxes for the shafts of these pumps are babbitted before the castings come to this bench, and here the shafts are put in, the bearings scraped, caps fitted up, the crossheads, connecting-rods, and other parts tested thoroughly.

Fig. 3 represents still a different class of work carried on at this plant. At the left, in the rear, is shown the largest type of pump made by the company. This is a triplex-geared and belt-driven machine for operating under high pressure. Immediately in front will be seen several lathe-bed castings, and at the right a heavy lathe in process of assembling. This company has during the past year entered the machine-tool building field, with a heavy projectile lathe.

The illustrations that follow are all reproductions of photographs taken in the Douglas foundry, giving typical operations. The first of these foundry views, Fig. 4, shows the mold for the lathe bed illustrated in Fig. 3. The flask is here seen open, the mold having been all rammed up and ready for closing for pouring. The drag is shown at the left of the picture, with the five cores in place for forming the openings between the cross-girts and the lathe bed. The mold for the headstock is seen rammed up in the cheek of the flask at the center of the illustration. This portion of the flask is provided at each end with substantial guides that fit over corresponding guide members projecting above the face of the drag to allow the heavy cheek to be dropped into position, so that the dowels will enter properly when the faces of the two portions of the flask come together. The cope, or nowel, is shown at the right ready for lifting by the crane and placing in position as the top member of the flask.

Fig. 5 illustrates three of the big ladles on the trolley rails, one ladle empty and ready for filling in front of the cupola, the one at the left filled for running down the foundry to a lot of floor work that is awaiting the arrival of the hot metal for pouring. In the immediate foreground are seen a large number of molds for small pumps, all rammed up for closing and pouring.

There is a great deal of bench work and machine work in this foundry, and some idea of its character will be gathered from Fig. 5 and from the other illustrations that follow. Fig. 6, for example, shows the machine

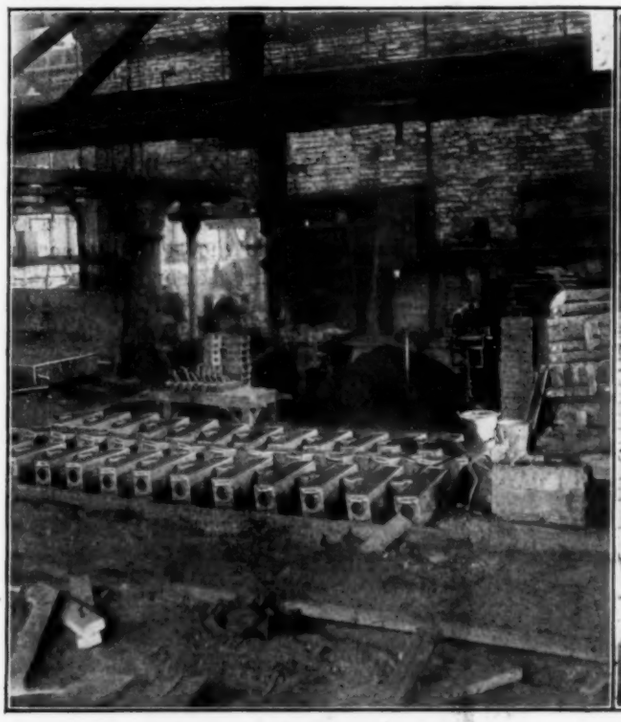


FIG. 7. SMALL MOLD READY FOR POURING

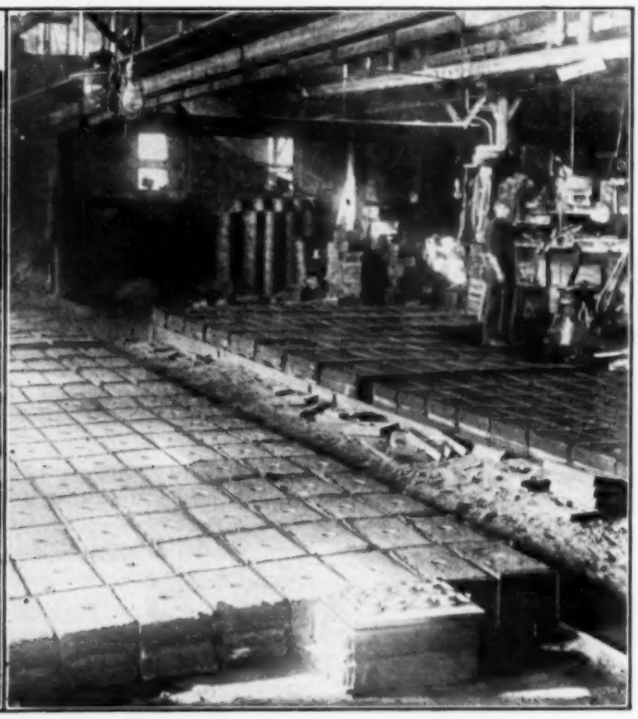


FIG. 8. MOLDS FOR SMALL PUMP PARTS

method of preparing the molds for the hot metal, this particular view showing molding machines used especially for right- and left-hand halves of the pump molds, each machine making its own half of the mold. The two machines are seen in the middle of the background of the view, the one in front with the flask removed, the one in the back with the flask ready for ramming up. Upon the completion of the ramming up of the molds the pattern is withdrawn by turning a crank at the end of the machine, drawing the pattern down flush with the surface, where the flask is lifted off. The machine in the center is shown with the patterns pulled out at the lowest point by the action of the crank.

The flasks are fitted with conveniently arranged handles so that they may be picked up and moved easily. A number of molds are shown open and closed on the foundry floor, and at the left will be seen two or three hinged flasks that are easily manipulated for the placing of patterns, ramming up of mold, setting of cores and preparing for pouring. The machine at the right is shown gated up with four patterns for similar pump parts that are small enough so that several of them may be rammed up simultaneously on the plate.

A large number of these flasks are of iron, as would naturally be the case with the smaller class of work, and a lot of these are shown on the foundry floor, Fig. 7, where they are placed for pouring. At the extreme left in the view will be seen the end of the cope portion of the three-part flask used for molding the big lathe bed referred to in connection with Fig. 4.

A good idea of the work of this foundry is gathered from Fig. 8, which shows several hundred molds closed and ready for the pouring operation. These pretty well cover one section of the foundry floor, and incidentally the view represents the method of handling hot metal up and down the line by the trolley system.

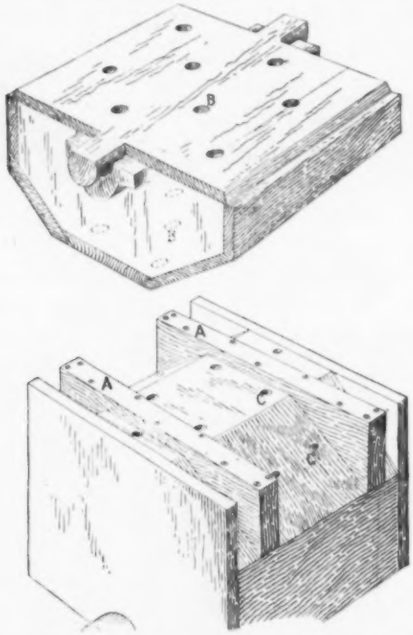
The work assigned to this type of flask is indicated by the gated pattern shown on top of the flask in the immediate foreground, where eight small cylindrical castings are molded at once, the work for this department being all bench or machine molding.

As already pointed out, the greater part of the process of manufacturing pumps is attended to in the foundry, the members thus produced without requiring further finishing than perhaps the drilling and tapping of certain holes and the fitting of some connecting member includes such parts as handles, air chambers, bases and the like.

Vent Holes in Patterns and Core Boxes

By John Parker

In the experience of all foundrymen one of the most unsatisfactory phases of the work is the hugging down of the sand in the mold or core box. This difficulty is



VENT HOLES IN PATTERNS AND CORE BOXES

caused by too little draft and by the pattern being too deep for the air to enter between the walls of the box and the sand or between the outside of the pattern and the sand. The result is what is commonly known as hugging or sucking of sand and pattern. The molder hammers the pattern to loosen the grip of the sand, or in case of a core box pounds the outside of the box till the battens *A* and the box are in a sorry state, requiring trips back and forth between the foundry and the pattern shop for repairs. This trouble could be eliminated, or helped in a great degree, by simply boring holes in the pattern at *B* or in the box at *C*, to allow air to reach the bottom of the mold or core, releasing the sand from the grip caused by air pressure.

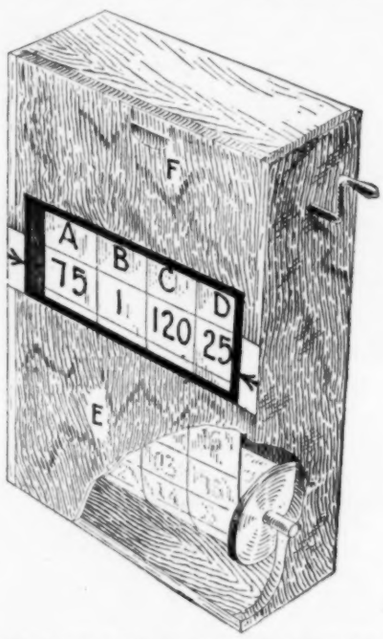
This is an old recipe, but the writer has been surprised to see how many foundrymen and pattern makers will stand by and patiently bother with core and mold or repair the pattern and core box repeatedly, when a little foresight and a bit and brace would avoid spoiling both the molds and the molder's temper, besides saving the expense of repairs to patterns and core boxes.

The writer has seen many patterns and boxes costing large sums ruined in a month's time by the pounding they received to draw them from the sand, when three or four holes through the pattern or the bottom of the core box would probably have saved them.

Dividing-Head Tables

By J. H. Moore

The miller dividing-head table shown in the accompanying illustration will, I am sure, be approved by operators of such machines. What is more confusing than the attempt to pick out a line of numbers from the mass.



CONVENIENT TABLE FOR DIVIDING HEADS

usually in small type, in the dividing-head tables? It takes considerable concentration of mind, and even then one is apt to make an error, especially after the list is well thumbed and soiled.

The table shown can be made from any box of convenient size (such as comes to the plant with large sizes of taps). The spools are easy to get. Hardly any further information is needed except that the box has a glass or mica front. The spaces *E* and *F* are painted black, while the remaining space is left transparent, to show the numbers as they appear. Spaces *A*, *B*, *C* and *D* are printed as follows: *A* has number of teeth, *B* the number of turns to handle, *C* has gear on handle, and *D* has the gear on worm stud.

Arrangement and Maintenance of Machine Tools*

By W. Rockwood Conover†

SYNOPSIS—An outline of the principles that should govern the selection, arrangement, care and maintenance of machine tools. Emphasis is placed on the value of a monthly inspection and report on every machine in the shop.

To attempt to discuss in detail or in a fully adequate manner all the features of advantage embodied in the various machine tools or other special tools which have been brought out in recent years by the tool builders and which enable the manufacturer to effect savings of greater or lesser proportions in his yearly output would open up a broad field of discussion, and would be of little interest, except in so far as the tools under consideration are adapted directly to the particular class of production in which the individual manufacturer is engaged.

When contemplating the purchase of new machine tools the manufacturer should aim to select the type or make of machine that has been proved by actual service, under both favorable and unfavorable conditions, to be best adapted to the specific purpose for which it has been designed and the specific work to be performed. He should not allow the personal opinion of the individual foreman or of the machine operator to bias or influence him in determining what tool to buy.

A complete record of all machine tools purchased and installed within the plant should be kept revised to date for constant reference. All tools should be assigned a catalog number; and the record should not only show the location of the tool, but should also give a description of the machine, its size, working dimensions, limits of speed and kind of work it is designed to do. If a machine is transferred from one department to another, the record should show the transfer in each case. This record should be so classified as to show all the tools of a similar type and all tools designed for similar classes of work grouped together in such convenient form that information concerning them can be obtained with facility. The value of such data will readily be recognized when the manufacturer is considering the purchase of tools like those already on hand in some portion of his factory.

Influence of Speeds on Production

The subject of speeds is one that requires careful study and observation and the exercise of wise judgment. Few manufacturers are getting the maximum production possible from their machine-tool equipment, owing to various causes. Some machines are operated at full capacity, while others fall below with varying percentages of loss. As in each department every foot of floor space occupied either by man or machine bears its relative proportion of investment cost and expense, the necessity for running machine tools to their full capacity consistent with economy and safety hardly needs touching upon. When the foreman's duties will not permit his devoting the necessary time to careful trial and investigation of speeds, it should be the duty of his assistants to conduct such investigations in each individual case as far as possible. If this practice is systematically and thoroughly followed in all departments of the factory, the tool investment can be kept within the lowest limit consistent with production requirements.

The tool operator needs to possess some knowledge of the kind of material he is about to cut and whether the depth of cut he proposes to take is practical and economical or not. A speed that may be demonstrated to be economical for one casting or class of material may not be advantageous or practical for another. If he is cutting steel, he needs to know something about the degree of its hardness—that is, the percentage of carbon in its composition. He should know that he can operate his tool at a much higher rate of speed on steel containing 0.20 to 0.30 of 1 per cent. of carbon than on steel containing 0.50 or 0.60 of 1 per cent. of carbon.

High-speed steel tools, because of greater endurance, make it possible greatly to increase the number of revolutions, but the workman must be able to determine the proper coarseness of feed in order to maintain a profitable rate of speed. With too coarse feed the tool becomes quickly heated, requiring too frequent changing, which causes a reduction in output; and proper accuracy and cleanness of cut are not assured. On the other hand, if the feed is too fine, the amount of material removed is not uniform with each revolution. The tool is not held to its work with equal and steady pressure at all times. It will do little or no cutting at one revolution and cut too deeply or roughly at the next, not producing a clean job. In cases of this kind the work presents a bad appearance.

With openhearth steels a speed as high as 250 ft. per min. may be obtained according to conditions, such as quality of finish required, rate of feed, etc. If the material to be machined is iron, the operator will naturally give consideration to the relatively slight difference between cast and malleable iron. A comparatively coarse feed in most instances can be taken, limited only by the quality of finish required, durability of tools and rate of peripheral speed that is demonstrated to be proper in relation to feed to produce the finished piece accurately and in the shortest space of time. In most classes of turret-lathe work the peripheral speed and coarseness of feed determine the rate of speed, the depth being a factor of minor importance that on many jobs need receive little consideration.

In general, the operator should have sufficient knowledge to judge carefully average conditions and arrive at satisfactory decisions in his work. Without such knowledge he is not properly qualified to operate his tool either efficiently or intelligently. The facility and precision with which he chucks or clamps his work, the time he takes to turn the turret head, throw in the feed, change or grind tools, etc., all indicate his efficiency

*Prepared for the author's forthcoming book on "Industrial Economics." Copyright, 1916, Hill Publishing Co.

†Factory economist, General Electric Co.

or lack of efficiency as a good mechanic. The factor of personal interest and ambition also has much to do with the output of machine tools, both as to quality and quantity.

There is a wide variation in economical speeds on almost any type of machine, governed by the character of the operation and materials used. Speeding a machine up too high naturally results in rapid wear of tools and consequently too frequent stoppage for grinding or exchange, which means decreased productive output to a degree that often more than offsets the gain made by the higher rate of speed. It may also affect the finished dimensions adversely. The actual amount of accurate work done will often be greater when a machine is operated at a medium rate of speed than when operated at a high rate, and this fact should always receive careful consideration.

Another element affecting the speed of machine tools is that of cutting lubricant. This should always be of a kind and quality to keep the point of the cutting tool thoroughly cool and well lubricated and should be supplied to the tool in ample volume, according to conditions.

With the advent of high-speed steels and the building of machine tools adapted to their use there has naturally come a change in the number of power tools operated by the individual employee. Previous to the period of their introduction the time of setting up a job was relatively short in comparison with the time occupied in the machine process itself; and under these conditions the operator tended two or more machines. In recent years high developments in speed of power-cutting tools, which have been secured in conjunction with the new steels, have resulted in reducing operating time to such an extent as entirely to change the ratio of the labor of setting-up to the production process and make it desirable in many cases for the operator to tend one or two machines only. The tendency in this direction has been fully justified by the increased product per machine and reduced labor cost of the individual piece.

It will be found a valuable help to the various foremen of the machine departments if accurate data on the efficiency and speed of machine tools in each individual department are prepared and kept available for use.

Arrangement of Machine Tools

The arrangement of machine tools is a subject that requires careful consideration. It should in all cases be governed by local conditions and the kind of product manufactured. It is the usual practice to centralize in one department machines that turn out product for the whole or a large portion of the plant, such as screw machines, polishing machines, grinders, etc. This plan is undoubtedly the most economical when we consider the expense of supervision and also the investment in machine-tool equipment. Under this system the number of machine tools can be limited to actual requirements, and as a rule, all the machines built to produce similar kinds or classes of work can be kept in constant operation. A falling off of production in one department of the plant will usually be compensated for by orders from another, so that under normal conditions all the machines will be kept busy. The labor of trucking the machined or finished parts to the various departments must necessarily be considered, but this item will generally be small in comparison with the other factors of expense and investment saved and the advantages gained.

It is often desirable, however, as in the case of decentralized departments or shops, to manufacture and finish all the parts for a given type of apparatus within the department itself. Under this plan, wherever practicable and the nature of the product will permit, the tools should be so arranged that the materials will pass in consecutive order of operation from one machine or set of machines to another and thence to the assembly floor or benches, with the minimum amount of labor handling by hand, truck or crane. Any arrangement that necessitates the movement of materials back and forth from one part of the floor to another or from one shop to another is not only expensive in operation, but also not infrequently the cause of delay in turning out the finished product.

In general, the best arrangement provides for the grouping of machines performing similar operations, such as lathes, planers, millers, gang drilling machines, etc., in such location as will aid the systematic movement of materials from operation to operation. Ample space should be provided between the different rows or tiers of machines to permit the free access of castings or other materials and to facilitate the handling of the same by the tool operator. There should be sufficient room so that platforms or boxes containing material may be placed in close proximity to the workman and in a position accessible to the floor laborer or truckman, in order that they can be quickly moved with an elevating transfer truck. The workman should not be compelled to place material on the shop floor because of lack of proper space and facilities about his tool.

The line-up of machine tools nearest the main or central aisle of the shop should provide ample space for platforms, material crates or boxes near the tools, leaving a broad, open, central way always clear for the free transportation of partly finished or finished product. This is true, also, where machine tools are placed in galleries or in long narrow areas of the shop. Too close setting of tools prevents the operator from handling his machine with the greatest safety and convenience and delays him in his work because of his cramped position and surroundings. Under such circumstances the floor becomes cluttered, is rarely properly cleaned, and the general tendency is to make the workman careless of the condition of his machine, if not generally slovenly.

The importance of furnishing ample space about machine tools cannot be too strongly emphasized. Congested aisles and gangways sometimes present the aspect of rush of business, but they as often indicate lack of proper executive knowledge and supervising ability. Such conditions give the shop a most untidy appearance in general; they not infrequently are the cause of serious accident and, beyond doubt, tend to raise the cost of production.

Decentralization of departments or classes of manufacture in large plants involves increased overhead expenses. The economic arrangement of machine tools in such cases must therefore obviously depend largely on local conditions and the advantages to be gained; and the individual manufacturer must necessarily be left to adopt the practice best suited to his own individual needs, the product he manufactures and the results he seeks to obtain.

The care of machine tools is of great importance. The work of preservation and proper maintenance is but half-accomplished if this feature receives but indifferent attention. A dirty or clogged oil cup is but little better than none at all, and the machine that is left to accumulate metal dust and gum up with oil residue will depreciate rapidly in proportion to the neglect. It is not sufficient to clean tools occasionally or to leave this work to the discretion of the operator. All slides and exposed surfaces should be cleaned at periods not exceeding one week, and shorter periods are preferable whenever practicable. This is especially true in the case of machines loaded with any of the various cutting compounds. Periodically all journals, spindle heads and turret heads, as well as unexposed bearing surfaces, should receive attention; and the frequency of this examination will obviously depend in no small degree on the quality of lubricant used.

The importance of frequent and thorough cleaning cannot be too often urged upon the workman or too strongly emphasized. The machine that is neglected rapidly degenerates, and the factor of depreciation necessarily becomes greater as time goes on. The slovenly workman soon finds the bearings and slides of his machine worn or clogged; and if his neglect is not the immediate cause of actual breakdown, in the end it results in increase in the tool maintenance and renewal account.

Points in Care and Maintenance

Particular attention should be paid to the care of roadways and the areas between machine shops, in order to prevent dust from entering through open doors and windows and coming in contact with the bearing surfaces or slides of valuable machine tools. The grit that in temperate or warm climates for the greater portion of the year fills the atmosphere of the shop during periods of wind is unquestionably detrimental to these bearing surfaces. Even where roadways are coated with preparations, it will be found desirable and necessary to keep them frequently and constantly sprinkled.

Detachable pans for the reception of oil drippings and chips, which are hung close up under the body of lathes, add much to the neatness and appearance of the department in which any number of these machines are concentrated. Not only are the floors more readily and easily cleaned, but the health and comfort of the employee are better preserved, particularly during the heated months of summer when the odors from saturated floors become increasingly obnoxious.

Maintenance of machine tools is a serious problem in the big shop. Every tool should be kept in a state of perfect repair and perfect adjustment if it is to produce perfect product. It is not possible for the operator to do good work if his machine is allowed to become loosened in any of its parts and remain out of alignment. During high peaks of production, when the factory is working overtime and the machine departments are rushed with orders, there is a tendency to ignore small repairs and delay the making of them until a more opportune time arrives when business is slack. This practice frequently necessitates operating the tool under strain, resulting in larger and more expensive repairs later on.

It is usually a fact in such factories that, when dull times arrive, the machine-tool equipment is found to require a general overhauling. A large percentage of this expense could have been saved, had the smaller repairs been made at once as the necessity occurred and the tools thus kept in working condition. The manager is often surprised at the close of the year to learn that the total cost of tool maintenance in his factory has mounted to many thousands of dollars. If this maintenance account exceeds 5 to 8 per cent. of his tool investment, after charging off depreciation, it is evidently high, and he has definite reason to consider investigation and action imperative.

A valuable economy in the tool-repair account can be effected by making regular monthly inspections of all machine tools. This should be done by the efficiency man, or by a regular experienced machinist. A card record should be kept showing the catalog number and name of each machine and stating its condition. If a machine is found in perfect order, the card should show the date of inspection, notation of its condition and be filed in the drawer where are kept the records of machines in good repair. If a machine is found on inspection to require repairing, a notation should be made on the card of the date of inspection and the cause and nature of the repairs required. This card is placed in the drawer containing record of repairs to be made. A shop order should be issued to cover cost of labor and material and the cost entered on the cards, together with the date the repairs were finished. The card is then placed in the drawer showing machines repaired.

The value of such a record is obvious. It shows several important facts relating to machine-tool equipment and investment, which may be briefly stated as follows: The frequency with which a given machine is repaired; the cost of maintenance of each individual machine in the factory; the durability and life of a tool made by one builder as compared with a similar tool doing similar work, but made by another builder; the maintenance cost of similar tools sold by different builders; the advisability of replacing with new tools those showing high maintenance cost; the degree of care and experience exercised by different operators in the handling of their tools where the working conditions are similar.

It is hardly necessary to enlarge upon the importance of the knowledge thus gained. Few manufacturers know either the cost of maintenance of any given type of machine or its durability and economy of operation, as compared with the machines of other builders designed to do similar work. More often a machine tool is bought on recommendation or guarantee of the maker or on the fact of its having been observed in duty in another shop. Quite frequently, low initial cost is the governing factor. Repairs, also, are sometimes looked upon as one of the necessary routine evils contingent upon the factory's operation.

It is good business in almost any shop to invest a certain amount yearly in replacing old machine tools with new uptodate types, which increase production and reduce costs.

All requests for shop orders for making repairs should receive the approval of the superintendent, in order that investigation can be made by him, where deemed advisable, before the shop foreman proceeds with the work. There are few emergency cases of such importance that they cannot be promptly brought to the attention of the proper official for approval before the company's money is expended for the necessary labor and material.

Railway Car-Wheel Flanges and Frog Clearances

The late A. M. Wellington once remarked that it would be difficult to find anywhere in engineering a small amount of metal performing such an important service with such marvelous reliability as that rendered by the flange of a railway car wheel. This little projecting lip on the rim of a car wheel, only about an inch in thickness and in height when the wheel is new, is the sole means of protecting from derailment every wheel of every railway train in the world. As is well known, the great bulk of the car wheels in service in the United States are made of cast iron, and the engineer as a rule hesitates to trust cast iron where it is to be subjected to transverse stress and to shocks; but the casting of car wheels has been so perfected that their record of safety and reliability in service leaves little to be desired.

When Mr. Wellington made the remark quoted, the average railway freight car had a capacity of 30,000 to 40,000 lb. Freight cars of the present day are built to carry a load of 100,000 lb., and many of higher capacities are in service. In addition to this there has been a notable increase in freight-train speeds with a corresponding increase in shocks to the wheels and axles.

There has been a general feeling that because of the increase in stresses to which car wheels are subjected some additional thickness should be given to the wheel flange so that it might better withstand the severe and incomputable stresses which it receives.

As every engineer connected with railway work knows, however, the present standard practice as to width of openings through frogs, switches and guard rails is based upon the use of car wheels with flanges of the present standard thickness, and any material increase in the flange thickness would necessitate an alteration in these track standards. The difficulty of altering these standards is apparent. A railway freight car in its wanderings may run over the tracks of any railway in the United States and Canada. It is impossible, therefore, for any single railway company to change the thickness of its car-wheel flanges without endangering the operation of these cars on every railway that did not alter its track standards to correspond. Moreover, if a thicker wheel flange were adopted by the railways of the United States for new cars, there would be fully a dozen years while the car wheels already in service were wearing out during which there would be a variation in flange thicknesses. It would be unwise, of course, to begin the changing of track standards until at least a large majority of the cars in service had the thicker flanges, and during all this transition period there would be increased danger of derailments at switches and frogs.

Nevertheless, the Association of Manufacturers of Chilled Railway Car Wheels recommended some time ago that car-wheel flanges should be increased in thickness about ¼ in. As a result of this recommendation, the matter has been under investigation by committees of the Master Car Builders Association and the American Railway Engineering Association. At the recent meeting of the former association held at Atlantic City, its committee submitted a report in which it said that "nothing will be gained in the interest of safety or economy by adding metal to any portion of the flange of cast-iron car wheels in such locations as will in any way affect track clearances."

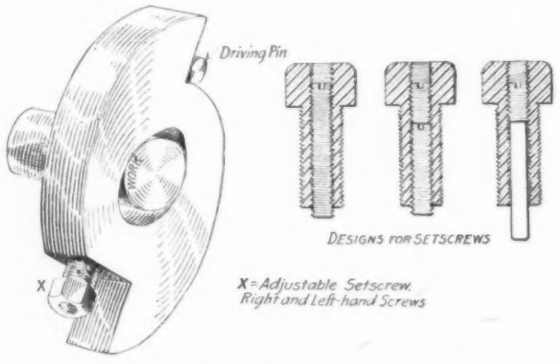
The investigation which led to this conclusion included a detailed study of car-wheel fractures and showed that the wheel fractures which caused derailments were almost invariably of a character that would not have been prevented by any increased thickness of the flange. Further than this, the committee reports that a certain railway had special wheels cast for use under its tenders having a flange ⅛ in. thicker than the standard. The average age of 203 of these wheels when condemned was 11 months, whereas of the same number of wheels with M. C. B. standard flanges in the same service the average age when condemned was 11.1 months. Of these thick-flanged wheels condemned, 28 per cent. were thrown out of service on account of worn flanges, while of the wheels condemned having M. C. B standard flanges but 15.2 per cent. were condemned on account of worn flanges. From this it would appear that the thickening of the wheel flange tends to increase the rate of flange wear. Two other railways reported to the committee that they had experimented with car wheels having thicker flanges and had found that the back of the flange in almost every case was grooved by contact with guard rails and frogs.

No better proof could be asked for that the present standard car-wheel flange is as thick as it can safely be made without a readjustment of track standards. The very great difficulty of maintaining safe operating conditions during the long transition period which would be necessary if a change in flange thickness were decided on has just been pointed out. It is exceedingly fortunate, therefore, that this small projection on the car-wheel rim, which seemed barely large enough for its work 25 years ago, is now proved to be still entirely reliable, notwithstanding the great increase in weights and speeds of rolling stock.—*Engineering News.*

Safety Lathe Dog

By George C. Lawrence

In the dog illustrated the setscrew is made adjustable for length to accommodate work of different diameters and at the same time keep the head well down behind



SAFETY LATHE DOG

the safety projection. I have also found this telescopic arrangement convenient in adjusting the length of driving pins.

Making the 4.5-In. Howitzer Cartridge Case--III*

By Robert Mawson

SYNOPSIS—This third section completes the article on manufacturing 4.5-in. cartridge cases. The operations are continued from the machining of the head of the case to the inspection, acceptance and packing. The gages, special small tools and attachments are shown in detail in a manner similar to that followed in the previous sections describing the machining of the case. The article as a whole thus makes a complete treatise on this size and type of cartridge case.

The thread is finish-tapped as the next operation. This is done in the drill press, Fig. 64. It will be noticed that the tap is fitted with a pilot, so that the thread will be tapped square. Details of the tap and pilot are given in Fig. 65 and of the pneumatic holding chuck in Fig. 66. The novel and valuable feature of this chuck is the method of locating the cartridge case. It will be observed that when the air pressure is admitted to the chuck the case is raised. It is then located against a finished flange on the chuck. As the outside face of the case flange has been accurately machined, the hole tapped and counterbored will thus be square with it, as the tap operates at right angles to the locating face of the chuck.

For this operation the same pneumatic holding chuck, Fig. 66, holds the case. The counterbore is shown in detail in Fig. 61 and is the same as used in the fifth suboperation of operation 25. The finish-counterboring operation is given in diagrammatical form in Fig. 69.

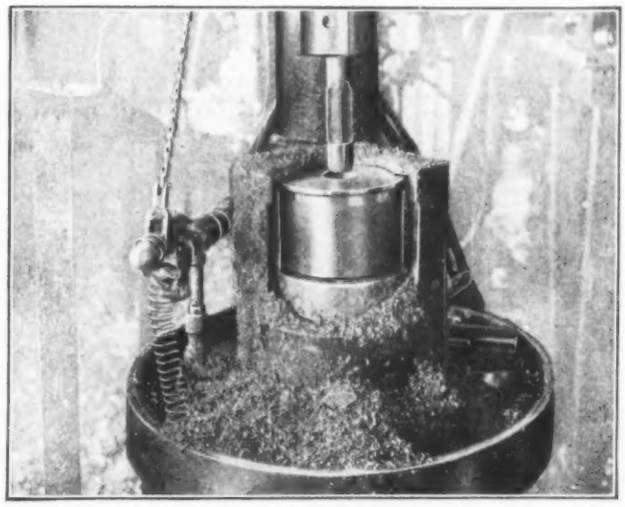


FIG. 64. TAPPING THE PRIMER HOLE

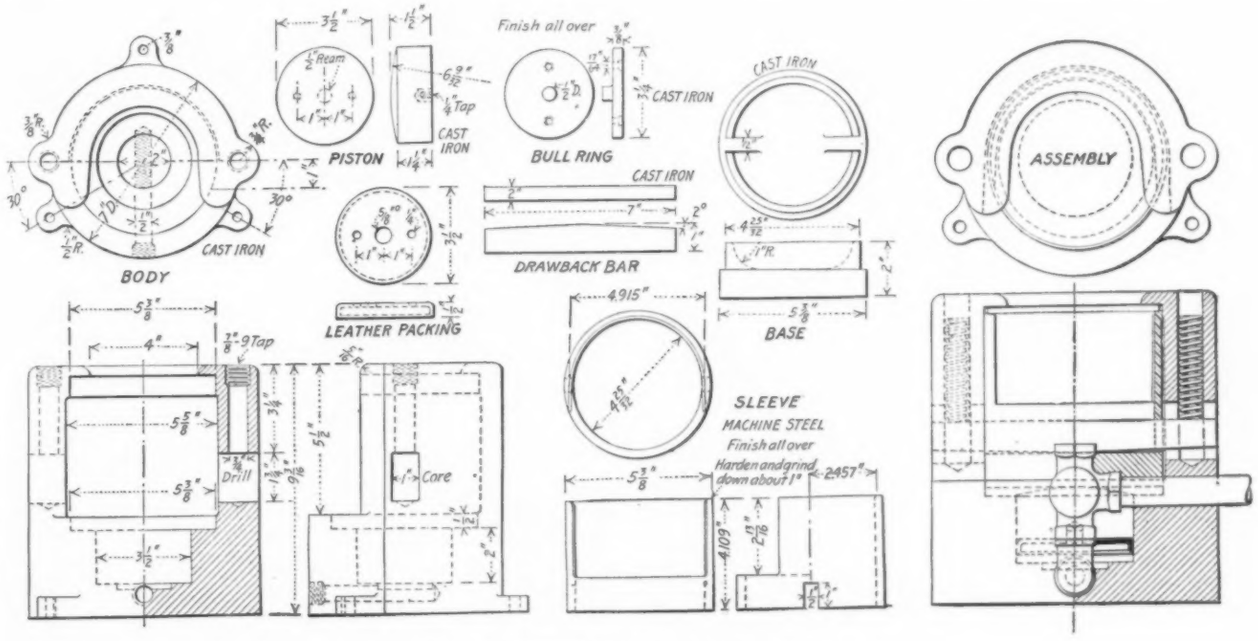


FIG. 66. PNEUMATIC HOLDING CHUCK

Lard oil is used during this tapping operation, also when rough-tapping in the twenty-fifth operation. The finish-threading operation is shown in diagrammatical form in Fig. 67.

The next operation is finish-counterboring. The drill press set up for this operation is illustrated in Fig. 68.

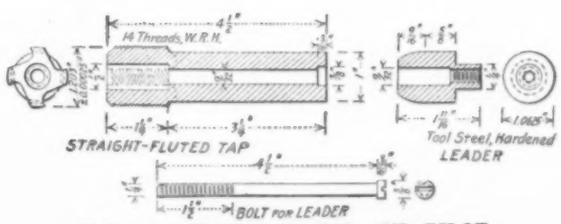


FIG. 65. DETAILS OF TAP AND PILOT

*Previous installments appeared on pages 21 and 67.

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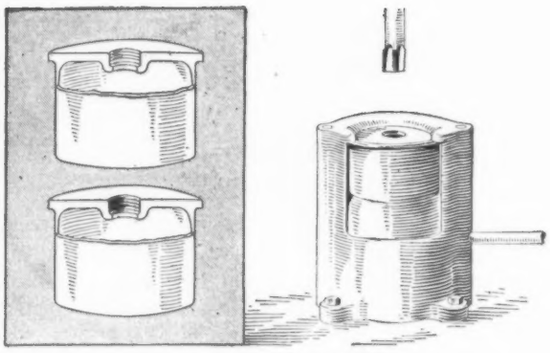


FIG. 67. OPERATION 26: FINISH-THREAD
Machine Used—Snyder drilling machine.
Production—380 per hr.
Lubricant—Lard oil.
References—Figs. 64, 65 and 66.
Note—Pilot used but not shown in the above illustration.

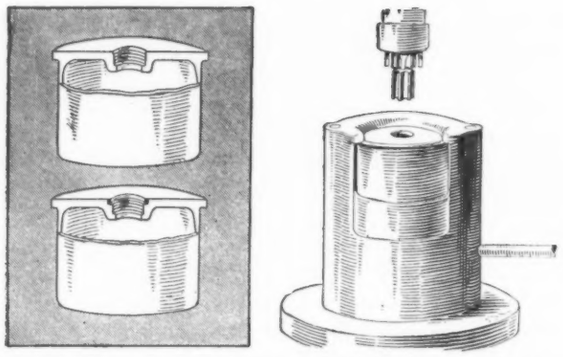


FIG. 69. OPERATION 27: FINISH-COUNTERBORE
Machines Used—Leland-Gifford and Barnes drilling machines.
Production—380 per hr.
References—Figs. 61, 66 and 68.

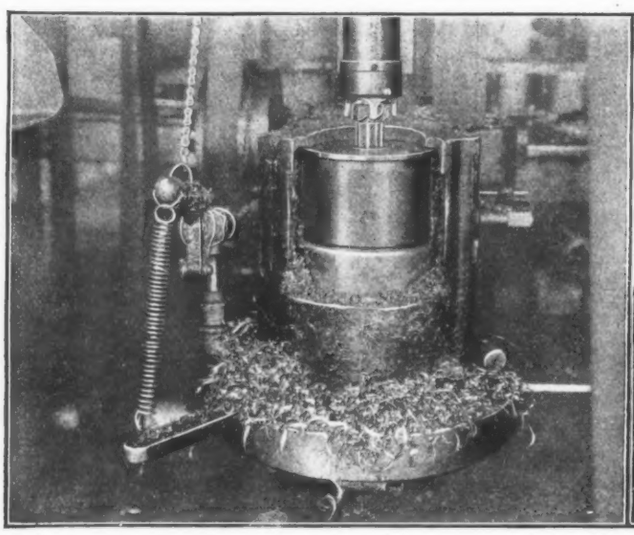


FIG. 68. COUNTERBORING THE PRIMER HOLE

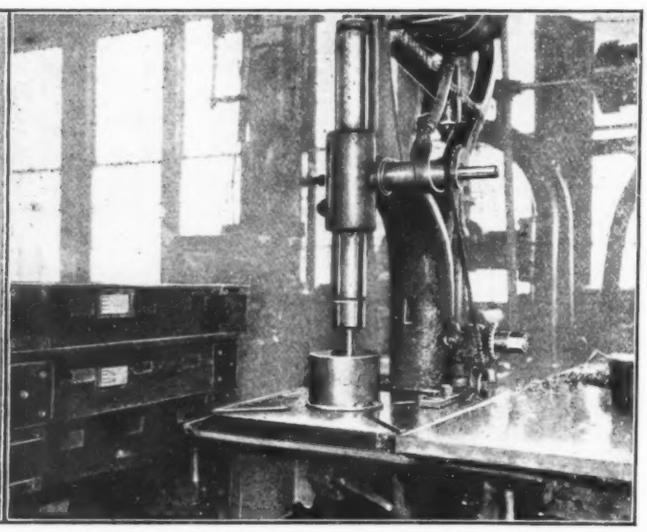
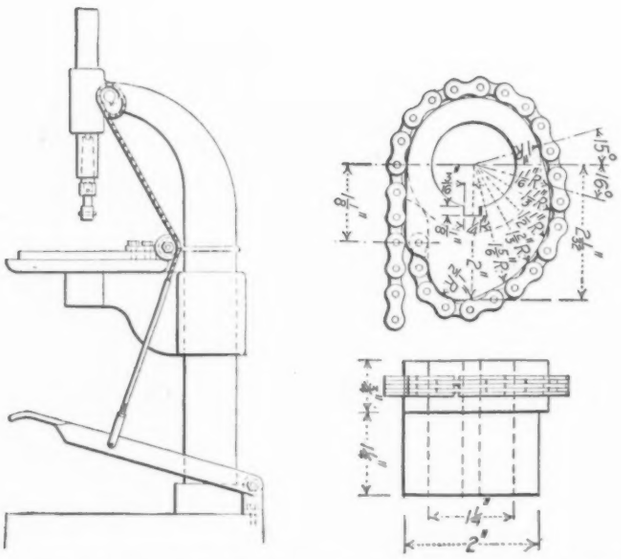


FIG. 70. FACING INSIDE BOSS


15°
16°
2⅜"
⅞"
⅜"
1¼"
1⅜"
1⅝"
1⅞"
1⅛"
1"
¾"
⅝"
½"
⅜"
¼"
⅛"
1⅝"
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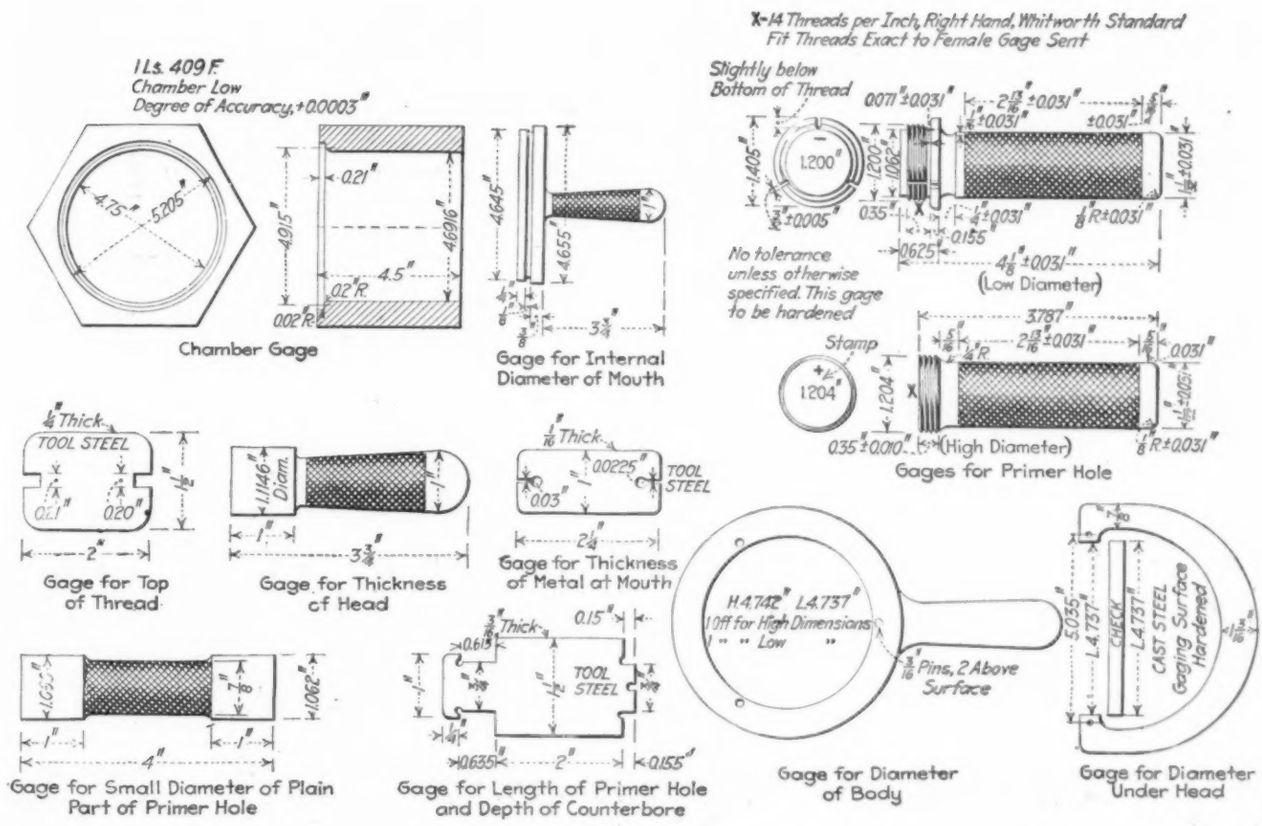

X-14 Threads per Inch, Right Hand, Whitworth Standard
Fit Threads Exact to Female Gage Sent
Ls. 409 F.
Chamber Low
Degree of Accuracy, ±0.0003"
Chamber Gage
Gage for Internal Diameter of Mouth
Slightly below Bottom of Thread
No tolerance unless otherwise specified. This gage to be hardened
(Low Diameter)
Stamp
(High Diameter)
Gages for Primer Hole
Gage for Top of Thread
Gage for Thickness of Head
Gage for Thickness of Metal at Mouth
Gage for Small Diameter of Plain Part of Primer Hole
Gage for Length of Primer Hole and Depth of Counterbore
H. 4.742" L. 4.737"
10ff for High Dimensions
1" " Low "
Pins, 2 Above Surface
CHECK
CAST STEEL Gaging Surface Hardened
Gage for Diameter of Body
Gage for Diameter Under Head

FIG. 73. GAGES FOR 4.5 HOWITZER CASE

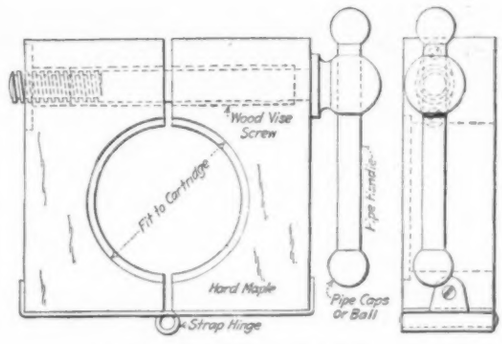


FIG. 74. SPECIAL HOLDING VISE

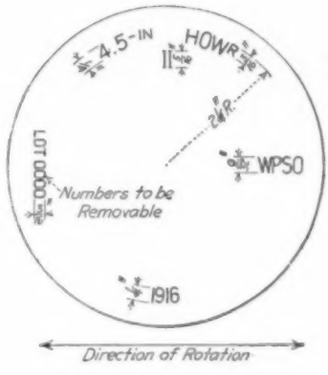


FIG. 77. DETAIL OF STAMP

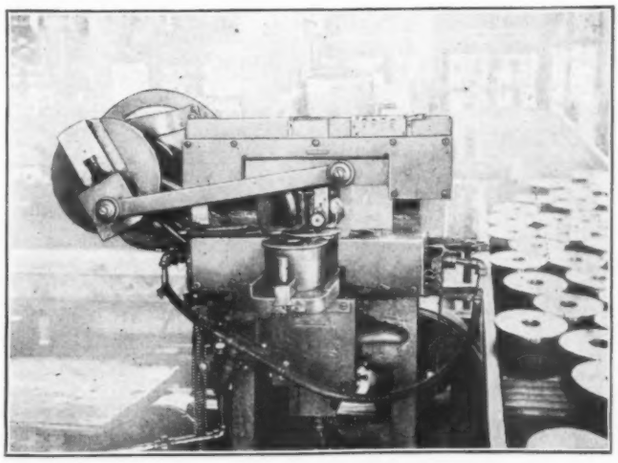


FIG. 75. STAMPING THE CASE

It will be seen by reference to the details, Fig. 71, that the spindle is operated with a foot treadle acting through a cam which revolves a gear that meshes with the rack cut on the spindle. By this arrangement the leverage of the cam is utilized as the force for the facing tool. The facing operation is also shown in diagrammatical form in Fig. 72. The cases are washed in a solution of water and caustic soda, heated to 150 deg. F., where they are allowed to remain for about 10 sec.

The next operation is the final inspection. The various gages for testing the cartridge cases are shown in Figs. 73 and 73-A. In Fig. 74 is shown a special vise to hold the case for any slight operation found necessary during the inspection. The rate of production on the inspection is approximately 65 per hour.

The cases are then conveyed, by means of the chute shown, from the inspection bench to the marking machine, Fig. 75, for stamping. Details of the special jaws

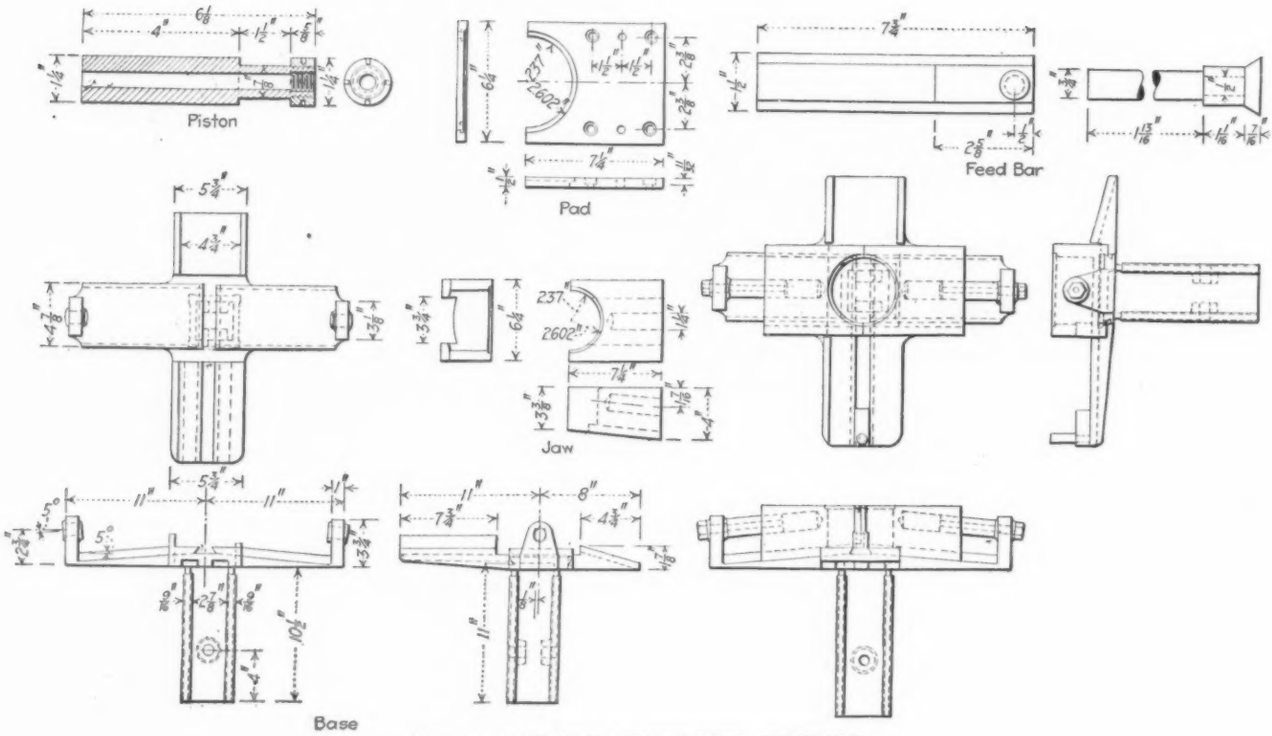


FIG. 76. DETAILS OF HOLDING FIXTURE

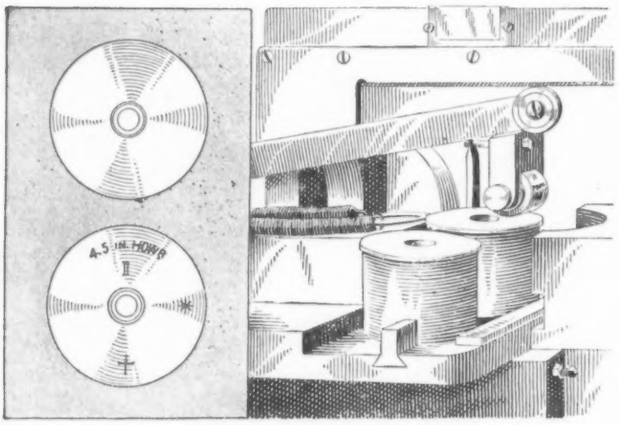


FIG. 78. OPERATION 31: STAMPING
Machine Used—Dwight-Slate marking machine.
Production—1,200 per hr.
References—Figs. 75, 76 and 77.

operated by air for holding the case are given in Fig. 76. It will be noticed that the jaws slide on a slight incline. By this means, when the case is in position under the stamp ready for marking, the pressure during the operation comes on the flange, thus avoiding injury to the thin wall of the open end of the cartridge case. A detail of the cartridge stamp is shown in Fig. 77. The stamping operation is given in diagrammatical form in Fig. 78.

The final operation is packing for shipment. The wooden case is made to hold 100 cartridge cases, which are placed in 5 layers of 20 each. Between each layer and around the insides of the packing case is placed corrugated paper. A view of one of the packing cases, partly filled, appears in Fig. 79, and the operation is also shown in diagrammatical form in Fig. 80.

In Fig. 81 is shown the method of conveying the filled packing cases. At the rear may be observed the

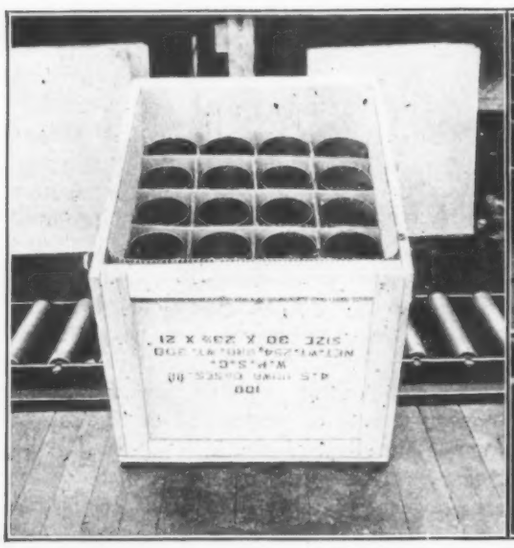


FIG. 79. CASE PARTLY PACKED

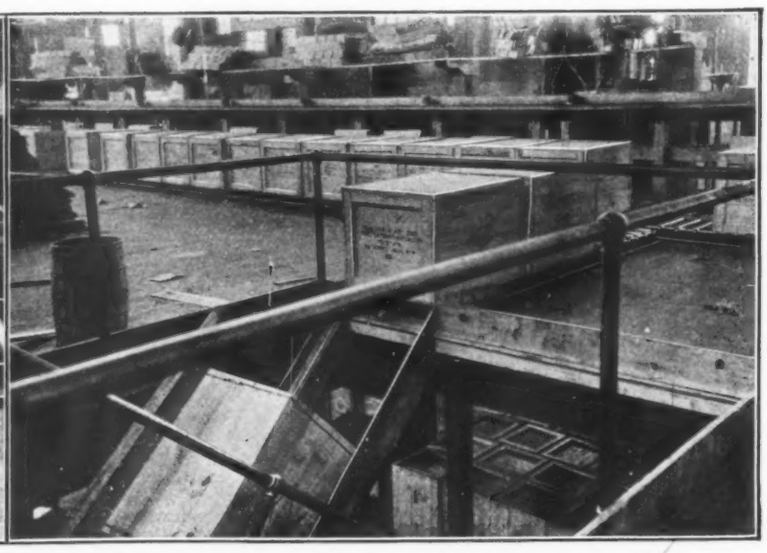


FIG. 81. VIEW OF CONVEYING SYSTEM

accepted and stamped cartridge cases being conveyed by an endless belt to men packing the wooden cases. After these have been filled, the cover is fastened down. The wooden cases are then pushed along the roller track and finally down the inclined chute shown. Such a method

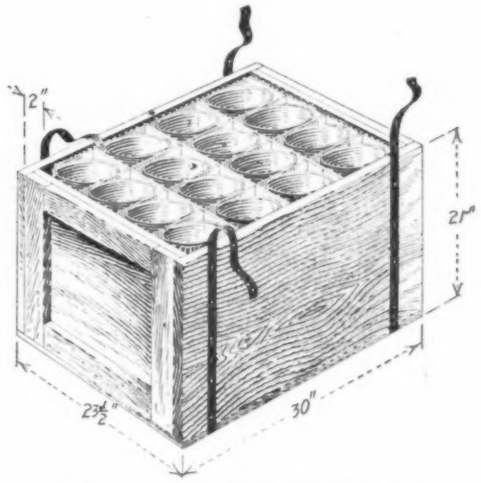


FIG. 80. OPERATION 32: PACKING
Production—One man packs 1,200 per hr.; one man fastens up boxes.
Reference—Fig. 79.

eliminates any lifting or carrying of the cartridge cases during the packing.

With the operations and tools here described the Worcester Pressed Steel Co. is producing the largest quantity of accepted 4.5-in. cartridge cases of any single concern in the United States, and the tools and methods were in successful operation very shortly after the first experimental case was made.

Design of Rolls for Making Steel Shrapnel Bars

By W. S. Standiford

The increasing orders of some of the belligerent nations for shrapnel shells and bars have resulted in manufacturers in this country making strenuous efforts to do the work. Many firms making widely diversified products are entering the munition field and manufacturing shrapnel, as it is a most lucrative business, the demand greatly exceeding the supply.

The metal from which the projectiles are made comes in round steel bars produced by rolling, which makes a dense and fine-grained metal well suited to the exacting processes of manufacture before the shells are ready for the guns. As steel bars form the basis from which the shrapnel is manufactured, the designs of the rolls, their proper adjustment and handling will be found interesting to the readers of this magazine. It may be thought that the shells could be made faster and better from castings containing the chamber for the powder and bullets, thus leaving very little metal to take off in the machining processes, instead of having to punch a hole in a solid steel blank and then finish the interior and exterior, as is done with each projectile made at the present time.

The reason that castings are not used for this purpose is that cast steel is a metal that usually contains blowholes, thus making it a dangerous material for shells, as they would be liable to burst in the guns. Another reason is that the weight and balance of a shell made from a solid bar give a steadier flight through the air than is characteristic of one made from a casting; in the latter case the heavier ingredients of the steel settle to the bottom during cooling, thus making certain parts of the walls of the projectile heavier than others, which disturbs its balance during flight.

The bar rolled is 3½ in. in diameter. This is the size used for the 18-lb. projectile for British guns, sufficient metal being in a bar of this size to allow for the machining operations to make the finished product.

The roughing rolls are three-high; they reduce the steel very quickly as compared with the two-high design. Quick reduction of the hot steel at the start is most important, as it is necessary to reduce the steel as rapidly as possible while it has a high heat, in order to make it fibrous, which is a quality desired. Referring to the roughing rolls, Fig. 1, it will be seen that each roll contains a box and edging pass, while the others are put in on an angle. Box and edging passes, by their shape, allow heavy drafts. The first and second passes work the metal on the top and bottom, there being little done on the sides. The illustration shows how the sides are made slanting toward the top of the groove, so that the bloom will leave the pass easily. If the sides were straight, the bloom would stick in the pass, some of the metal being forced between the collars, which would be broken. In actual practice the sides of the box and edging passes are opened out 6 deg., the width at the bottom being just enough so that it will fit the bloom. The box, edging and angle passes all contain fillets at the bottom,

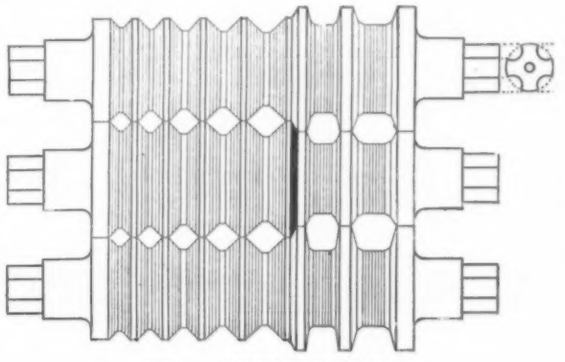


FIG. 1. ROUGHING ROLLS

so that the corners of the bloom will be worked as much as possible, in order to make all parts of the bar uniform in strength.

Roughing rolls are made of either chilled cast iron or steel, the latter being preferred, as it withstands rough usage better. It occasionally happens that a pair of tongs will slip out of the rougher's hands and go into the rolls. If the rolls are made of cast iron, a collar will be broken off; thus the set will be idle until a new roll can be turned. Should a pair of tongs go into steel rolls, the tongs will be cut in two—the collar edge where it cut the tongs will be dented, but this does not prevent the rolls from working.

As it takes a blacksmith about one hour to make a pair of tongs, while it will consume about one week's time to turn a new roll, it will readily be seen that steel roughing rolls are more economical than cast-iron ones. In purchasing steel rolls it is best to get a metal having a high-carbon content, as they will wear better in the mill

and do not bend, which latter characteristic is usually seen in the small-sized guide roughers used in a 10-in. mill. Following is a chemical analysis of roll steel, which is considered "next to the ideal metal" by chemists. Rolls of this analysis have withstood the roughest kind of usage in the mill and last long in the housings before requiring dressing in the lathe.

Carbon combined	0.49
Silicon	0.211
Sulphur	0.036
Phosphorus	0.041
Manganese	0.68

To make the 3½-in. round bars, bessemer or open-hearth steel blooms 8 in. square and 2½ ft. long are used. They are pushed through the box and edging passes, emerging in the shape of a long, square bar.

The work done on the bloom by the passes has so compacted the metal that when the angle grooves are reached there is very little flashing of the molten steel coming from the bar, as is the case when the bloom first enters the rolls. The full number of grooves in both sets are not shown in Figs. 1 and 2, this being done for clearness and to keep the size down within reasonable limits.

The angle grooves have an angle of 95 deg., and by their position in the rolls work the bar mostly on the top and bottom corners. The corners of the bar at the sides have no work done on them while the bar is going through one pass. Before it goes through the next smaller groove, the bar is turned over at a right angle to its previous position; thus the two corners which were at the sides of the pass have work done on them. The bar goes through the angle passes alternately until it is reduced to 4 in. in diameter; then it is ready for rolling in the finishing rolls, Fig. 2. These are usually made of hard cast iron. Some mills use chilled rolls for making their hand rounds. The chilled rolls last longer before requiring dressing; but being very brittle, the collars between the passes are liable to break out if a sliver on a bar wedges itself between them.

The grooves in the hand rounds are put in by means of round steel plugs, as hard as fire and water can make them. They are ground after hardening, as the latter throws them out of true circular form. Tools for use on the roll lathe work best when left as hard as it is possible to get them. The pass is cut down in each roll to nearly half the diameter of the plug, sufficient clearance being allowed so that, when in the mill, the rolls will not have to touch each other; ⅛ in. clearance is the usual allowance. This is to prevent the collars between the passes from breaking out on their peripheries, which is likely to happen when rolls are pressed against each other while working. After the groove is turned in the roll to the proper depth, the steel plug is withdrawn and a tool put in that widens the sides of the pass and rounds the corners at the same time, but does not touch the center.

This tool is then removed, and the pass with its cut-away sides has the appearance illustrated in Fig. 2. The other grooves in both rolls are turned the same way, care being taken to have them exactly opposite one another. The reason that the sides of each groove have to be cut away for a short distance is to prevent a long ridge, or fin, on each side of the bar at the joints of the rolls. The 4-in. square bar from the roughing rolls goes once through the 3¾-in. pass. It is then turned over at a right angle to its previous position and pushed into the 3½-in. finishing pass.

As the bar from the 3¾-in. groove passes through the 3½-in. one, the metal spreads out in the beveled sides and is about $\frac{7}{16}$ in. wider at the sides than at the top and bottom. It is then turned over at a right angle, so that the wide part is touching the top and bottom of the groove, and is rolled again, after which it is again turned over at a right angle to its previous position and receives the final rolling.

The last rolling which the bar receives rounds out slight inequalities that may exist on the surface. The shaded outline of the finished bar shows that the total width of the cut-away clearance part of the pass is very small. In the manufacture of round iron or steel bars by the use of rolls it is impossible, by rolling, to produce a bar that measures the same on all sides, the variation

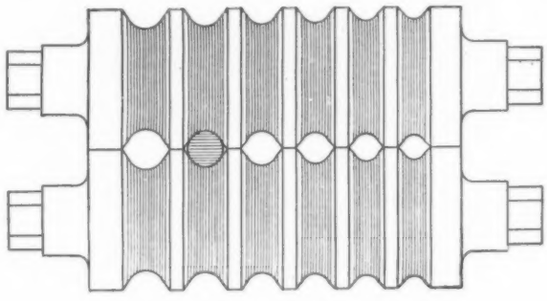


FIG. 2. HAND ROUND ROLLS

from a true circular shape being about 0.007 in., although some manufacturers, by placing an extra set of rolls in front of, and at an angle to, the regular ones make a bar having a variation of only 0.003 in. oversize, which is about the best that can be done.

It is a fact that the consumers' demands for exactly sized rounds is increasing every year. To get such results in keeping the variation in size down to a few thousandths of an inch requires the utmost care and skillful setting and handling of the rolls by the roller—and it also takes a roller who knows his business, as no amateur roller can set and maintain the rolls in position to make accurate rounds. The best that the ordinary roller can do is to make round iron or steel bars $\frac{1}{64}$ in. out of true circular form. This is due to incorrect setting and handling of the rolls, such as inserting the metal at too high a heat in the finishers, not having the grooves in line and not turning the metal over at an exact right angle at each rolling in the finishing pass. Too low a temperature in the finishing pass also influences the shape of the bar and makes it uneven in size. Thus when the bar has places on it that are relatively cold to other parts, in going through the rolls the cold spots cause the rolls to spring more than on the hot parts, thus making the bar larger in diameter at those places. If there are a number of cold spots on a bloom, due to careless heating in the furnace, the finished bar will be wavy in appearance. It is necessary to have the metal at a uniform temperature and evenly heated all through, if fine bars are desired.

In buying steel for shrapnel shells the requirements of the purchaser are even more exacting. This makes the manufacture of shrapnel bars an expensive operation. As an example: Bars for high-explosive shells call for a discard of 40 per cent. of the ingot; bars for shrapnel, 30 per cent.; and ordinary steel bars, about 15 per cent. The bars for high-explosive and shrapnel shells are subjected to rigid inspection.

A Method of Cutting Cams

By F. P. Ampudia

With the method here described, when one has to design a cam it is not necessary to make a detail drawing; but a small sketch is made showing the dimension and direction of rotation of time, as shown in Fig. 1, which also gives a table diagram that represents numerically the movements of cams by degrees, and the cuts in the milling machine by thousandths of an inch.

With this table the operator places in the milling machine the cams to be cut, in accordance with the numbers indicated. The operations are executed by following the data on the diagrams given.

On the upper part of the sheet, as in Fig. 1, a description indicating by degrees the times, direction and dimensions is made. On the opposite side a sketch is drawn that will show the times and directions and the table is compiled as shown, each division representing a degree.

The first column gives degrees, the second column the numbers of thousandths of inches that are to be cut, and the third column the total, representing the cuts.

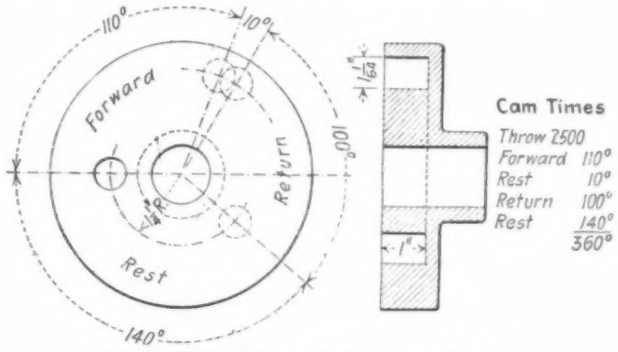


FIG. 1. DIMENSION AND DIRECTION OF ROTATION OF TIME

TABLE METHOD OF LAYING OUT FACE CAM

Degrees	Thousandths of an Inch To Be Cut	Thousandths of an Inch, Sum	Degrees	Thousandths of an Inch To Be Cut	Thousandths of an Inch, Sum	Degrees	Thousandths of an Inch To Be Cut	Thousandths of an Inch, Sum
1	2	2	47	14	611	93	14	1,255
2	3	5	48	14	625	94	14	1,269
3	5	10	49	14	639	95	14	1,283
4	7	17	50	14	653	96	14	1,297
5	9	26	51	14	667	97	14	1,311
6	11	37	52	14	681	98	14	1,325
7	14	51	53	14	695	99	14	1,339
8	14	65	54	14	709	100	14	1,353
9	14	79	55	14	723	101	14	1,367
10	14	93	56	14	737	102	14	1,381
11	14	107	57	14	751	103	14	1,395
12	14	121	58	14	765	104	13	1,409
13	14	135	59	14	779	105	13	1,423
14	14	149	60	14	793	106	13	1,437
15	14	163	61	14	807	107	13	1,451
16	14	177	62	14	821	108	13	1,465
17	14	191	63	14	835	109	13	1,479
18	14	205	64	14	849	110	13	1,493
19	14	210	65	14	863	111	13	1,507
20	14	233	66	14	877	112	13	1,521
21	14	247	67	14	891	113	13	1,535
22	14	261	68	14	905	114	13	1,549
23	14	275	69	14	919	115	13	1,563
24	14	289	70	14	933	116	13	1,577
25	14	303	71	14	947	117	13	1,591
26	14	317	72	14	961	118	13	1,605
27	14	331	73	14	975	119	13	1,619
28	14	345	74	14	989	120	11	1,630
29	14	359	75	14	1,003	121	9	1,639
30	14	373	76	14	1,017	122	7	1,646
31	14	487	77	14	1,031	123	5	1,651
32	14	401	78	14	1,045	124	3	1,654
33	14	415	79	14	1,059	125	2	1,656
34	14	429	80	14	1,073			
35	14	443	81	14	1,087	Rest 10		
36	14	457	82	14	1,104	Return 125		
37	14	471	83	14	1,115	Rest 100		
38	14	485	84	14	1,129			
39	14	499	85	14	1,143			
40	14	513	86	14	1,157			
41	14	527	87	14	1,171			
42	14	541	88	14	1,185			
43	14	555	89	14	1,199			
44	14	569	90	14	1,213			
45	14	583	91	14	1,227			
46	14	594	92	14	1,241			

Throw = 144 = 1.656

TABLE 1. MILLING-MACHINE CUTS

Degrees	Thousandths of an Inch To Be Cut	Thousandths of an Inch, Sum	Degrees	Thousandths of an Inch To Be Cut	Thousandths of an Inch, Sum	Degrees	Thousandths of an Inch To Be Cut	Thousandths of an Inch, Subtract
1	3	3	79	24	1,829	150	27	1,790
2	5	8	80	24	1,853	151	27	1,763
3	8	16	81	24	1,877	152	27	1,736
4	13	29	82	24	1,901	153	27	1,709
5	18	47	83	24	1,925	154	27	1,68..
6	24	71	84	24	1,949	155	27	1,655
7	24	95	85	24	1,973	156	27	1,628
8	24	119	86	24	1,997	157	27	1,601
9	24	143	87	24	2,021	158	27	1,574
10	24	167	88	24	2,045	159	27	1,547
11	24	191	89	24	2,069	160	27	1,520
12	24	215	90	24	2,093	161	27	1,493
13	24	239	91	24	2,117	162	27	1,466
14	24	263	92	24	2,141	163	27	1,439
15	24	287	93	24	2,165	164	27	1,412
16	24	311	94	24	2,189	165	27	1,385
17	24	335	95	24	2,213	166	27	1,358
18	24	359	96	24	2,237	167	27	1,331
19	24	383	97	24	2,261	168	27	1,304
20	24	407	98	24	2,285	169	27	1,277
21	24	431	99	24	2,309	170	27	1,250
22	24	455	100	24	2,333	171	27	1,223
23	24	479	101	24	2,357	172	27	1,196
24	24	503	102	24	2,381	173	27	1,169
25	24	527	103	24	2,405	174	27	1,142
26	24	551	104	24	2,429	175	27	1,115
27	24	575	105	24	2,453	176	27	1,088
28	24	599	106	18	2,471	177	27	1,061
29	24	623	107	13	2,484	178	27	1,034
30	24	647	108	8	2,492	179	27	1,007
31	24	671	109	5	2,497	180	27	980
32	24	695	110	3	2,500	181	27	953
33	24	719	111		2,500	182	27	926
34	24	743	112		2,500	183	27	899
35	24	767	113		2,500	184	27	872
36	24	791	114		2,500	185	27	845
37	24	815	115		2,500	186	27	818
38	24	839	116	Rest 10°	2,500	187	27	791
39	24	863	117		2,500	188	27	764
40	24	887	118		2,500	189	27	737
41	24	911	119		2,500	190	27	710
42	24	935	120		2,500	191	27	683
43	24	959				192	27	656
44	24	983				193	27	629
45	24	1,007		Thousandths of an	Thousandths of an	194	27	602
46	24	1,031				195	27	575
47	24	1,055				196	27	548
48	24	1,079	Degrees	Inch To Be Cut	Inch, Subtract	197	27	521
49	24	1,103				198	27	494
50	24	1,127				199	27	467
51	24	1,151	121	3	2,497	200	27	440
52	24	1,175	122	5	2,492	201	27	413
53	25	1,200	123	8	2,484	202	27	386
54	25	1,225	124	13	2,471	203	27	359
55	25	1,250	125	18	2,453	204	26	333
56	25	1,275	126	26	2,427	205	26	307
57	25	1,300	127	26	2,401	206	26	281
58	25	1,325	128	26	2,375	207	26	255
59	24	1,349	129	26	2,349	208	26	229
60	24	1,373	130	26	2,323	209	26	203
61	24	1,397	131	26	2,297	210	26	177
62	24	1,421	132	26	2,271	211	26	151
63	24	1,445	133	26	2,245	212	26	125
64	24	1,469	134	26	2,219	213	26	99
65	24	1,493	135	26	2,193	214	26	73
66	24	1,517	136	26	2,167	215	26	47
67	24	1,541	137	26	2,141	216	18	29
68	24	1,565	138	27	2,114	217	13	16
69	24	1,589	139	27	2,087	218	8	8
70	24	1,613	140	27	2,060	219	5	3
71	24	1,637	141	27	2,033	220	3	00
72	24	1,661	142	27	2,006			
73	24	1,685	143	27	1,979			
74	24	1,709	144	27	1,952			
75	24	1,733	145	27	1,925			
76	24	1,757	146	27	1,898			
77	24	1,781	147	27	1,871			
78	24	1,805	148	27	1,844			
			149	27	1,817	Rest 140°		

In order to prevent roughed surfaces when cutting a cam, owing to the irregularity of the cam curves and the difficulty in smoothly converting angles into curves, the angles should be cut before the curves.

Referring to Table 1, it will be seen that the first five degrees and the last five degrees to 110 deg. of the cam begin with 0.003 in., and they are increased by degrees up to the fifth, that is, 0.018 in. The same cuts when reversed should be given from 110 to 106 deg. Now the five first and five last degrees, representing 0.094, must be deducted from the 2,500 thousandths of an inch of the throw and also the 10 thousandths of an inch subtracted from the 110 deg. corresponding to the cuts. After this the remainder, or in other words 100 cuts, or one throw of 2,406, or $\frac{2,500 - 94}{110 - 10} = \frac{2,406}{100} = 24 + 0.06$. These figures show that we shall have to make 94 cuts to 24 thousandths of an inch and six cuts to 25 thousandths

of an inch. In order to give more uniformity to the cam, the six cuts of the 25 thousandths of an inch are to be given in the center that will correspond to the degrees between 53 and 59 deg. Following the diagram in its corresponding column, the operator will readily see that the number of thousandths of an inch cut are to correspond with the diagram, serving to check constantly the operation of the cut reaching to 110 deg. The diagram then shows 10 deg. rest up to 120 deg.; the return of 100 up to 220 deg. is done by subtracting on the cut 2,500 thousandths of an inch from the throw. By following the above explanation it will be found that the five first and the five last are to be indicated exactly the same, or 94 thousandths of an inch in 10 deg. For the remaining cuts $\frac{2,500 - 94}{100 - 10} = \frac{2,406}{90} = 26 + 0.66$, or in other words 44 cuts to 26 thousandths of an inch, and 66 cuts to 27 thousandths of an inch.

After the face has been finished and the holes drilled from the center of the radius, indicated on the illustration, the cam is placed on the spiral dividing head and placed on the work table. Then the cutter is attached to the clutch-driving cutter collar. By the dividing head we have the degrees, and by moving the elevating shaft we obtain the thousandths of an inch.

In Table 2 is shown a similar table used in machining a three-lobe cam. The graphic method, as used when laying out a face cam, is shown in Fig. 3, and the table method here described is shown separately.

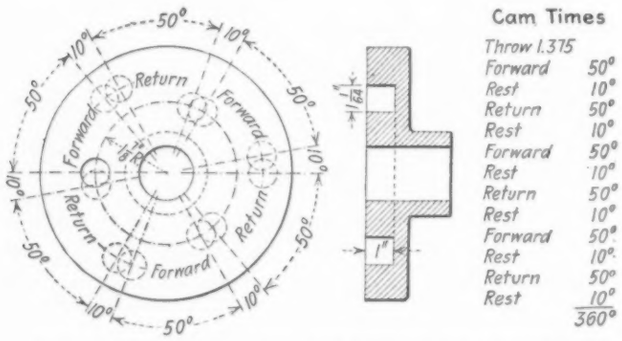


FIG. 2. DIMENSION AND DIRECTION OF ROTATION THREE-LOBE CAM

TABLE 2. CAM WITH THREE CUTS

Degrees	Thousandths of an Inch To Be Cut	Thousandths of an Inch, Sum	Degrees	Thousandths of an Inch To Be Cut	Thousandths of an Inch, Sum	Degrees	Thousandths of an Inch To Be Cut	Thousandths of an Inch, Subtract
1	3	3	43	32	1,263	79	32	879
2	5	8	44	32	1,295	80	32	847
3	9	17	45	32	1,327	81	32	815
4	13	30	46	17	1,344	82	32	783
5	17	47	47	13	1,357	83	32	751
6	32	79	48	9	1,366	84	32	719
7	32	111	49	6	1,372	85	32	687
8	32	143	50	3	1,375	86	32	655
9	32	175	51		1,375	87	32	623
10	32	207	52		1,375	88	32	591
11	32	239	53		1,375	89	32	559
12	32	271	54		1,375	90	32	527
13	32	303	55	Rest 10°	1,375	91	32	495
14	32	335	56		1,375	92	32	463
15	32	367	57		1,375	93	32	431
16	32	399	58		1,375	94	32	399
17	32	431	59		1,375	95	32	367
18	32	463	60		1,375	96	32	335
19	32	495				97	32	303
20	32	527		Thousandths of an Inch To Be Cut	Thousandths of an Inch, Subtract	98	32	271
21	32	559				99	32	239
22	32	591				100	32	207
23	32	623	Degrees			101	32	175
24	32	655				102	32	143
25	32	687	61	3	1,372	103	32	111
26	32	719	62	6	1,366	104	32	79
27	32	751	63	9	1,357	105	32	47
28	32	783	64	13	1,344	106	17	30
29	32	815	65	17	1,327	107	13	17
30	32	847	66	32	1,295	108	9	8
31	32	879	67	32	1,263	109	5	3
32	32	911	68	32	1,231	110	3	00
33	32	943	69	32	1,199	111		
34	32	975	70	32	1,167	112		
35	32	1,007	71	32	1,135	113		
36	32	1,039	72	32	1,103	114		
37	32	1,071	73	32	1,071	115		
38	32	1,103	74	32	1,039	116	Rest 10°	
39	32	1,135	75	32	1,007	117		
40	32	1,167	76	32	975	118		
41	32	1,199	77	32	943	119		
42	32	1,231	78	32	911	120		

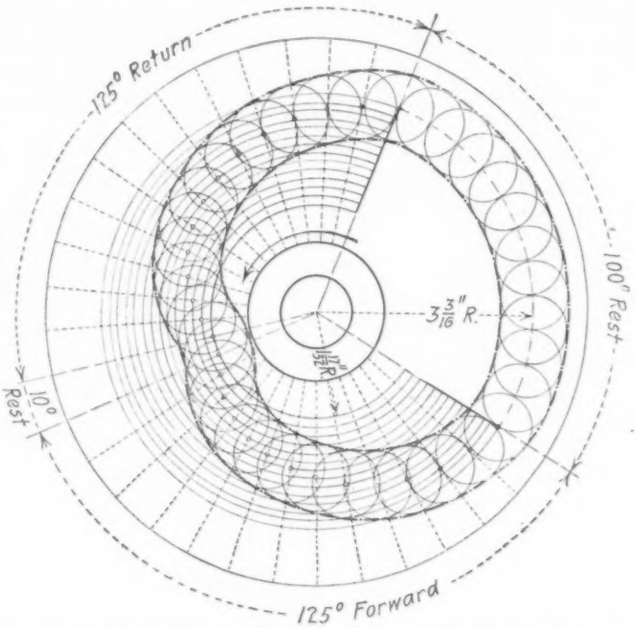
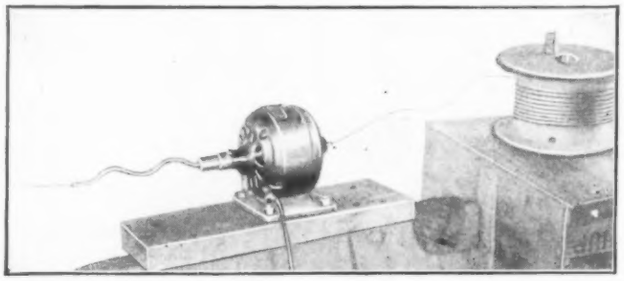


FIG. 3. GRAPHIC METHOD OF LAYING OUT FACE CAM

Wire Straightener

By E. V. Allen

A rather novel wire straightener, here shown, is used in the shop of the Campbell Industrial Co., Chicago. This company makes car seals and the like and uses a large number of small wire springs. The wire is about 22-gage coppered spring wire. The straightener itself consists of a rod with a hole drilled through it lengthwise. This rod is bent as shown and fastened to the spindle of a small electric motor that runs about 1,800 r.p.m. The wire feeds from the spool in through the hollow motor spindle and out of the end of the wavy rod. The wire is flexible enough to be easily threaded through the hole when starting, and the result is as satisfactory as if a more expensive and complicated machine was used.



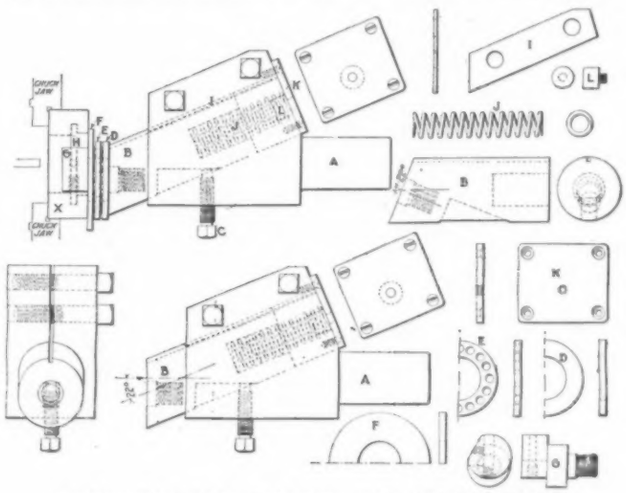
A SIMPLE WIRE-STRAIGHTENING DEVICE OPERATED BY ELECTRIC MOTOR

The wire feeds from the roll at the right and is pulled through to the left.

Letters from Practical Men

Recessing Tool Holder for Heavy Work

We had a lot of trouble in recessing the gear *X*, shown in the illustration. This gear, which is made of chrome-nickel steel and finished on a 5A Potter & Johnston auto-



RECESSING TOOL HOLDER FOR HEAVY WORK

matic, has a 2¼-in. hole. It is counterbored $2\frac{7}{16}$ in. in diameter, $\frac{11}{16}$ in. deep and has a recess ¼ in. wide, 3⅛ in. in diameter and $\frac{11}{16}$ in. from the face.

The recessing tool holder is very easily made. It consists of a main body *A*, the shank of which is turned to fit the turret of the machine. A hole is bored at an angle of 22 deg. with the center line of the shank. I find that this angle gives the best results. The body is split, and the key *I* is fitted and held in place by two setscrews. The plate *K* is fastened on the back to take the thrust of the spring *J*. A plug *L* is fixed on the plate to keep the spring central. The slide bar *B* is made a sliding fit in the body. It is bored and threaded to fit the tool holder *G*, and a keyway is cut the full length to fit the key *I*. It is bored on the opposite end to take the spring *J*. There are two hardened and ground washers *D* and *E*. A brass washer *E* has balls fitted into it. The tool holder *G* carries the washers *D*, *E* and *F* and the tool *H*.

When the turret comes forward, the washer *F* comes in contact with the face of the work. As the turret advances, the bar *B* moves up on the angle, the tool *H* is forced into the work, and the recess is formed. When the recess is completed, the backward motion of the turret allows the spring to return the bar to the starting point. The setscrew *C* acts as the stop. The bar *B* is milled to take the point of this screw.

Any size of hole can be recessed with this holder by making a special holder on the same lines as the holder *G*. Adjustment to bring the tool holder *G* central with the bore is made with the setscrew *C*. A holder made the same as this one is working at the present time and gives an increase in production over one used before.

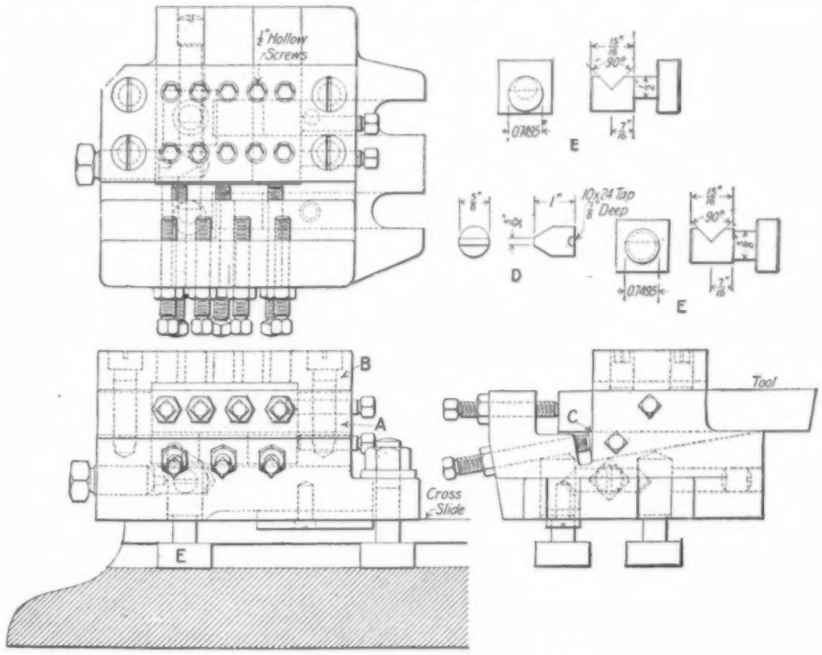
Philadelphia, Penn. GEORGE GOLDING.

Tool Post for Flat Forming

We frequently have jobs on the Cleveland automatic screw machines where we could drill and form at the same time if we had no interference, but very often the reamer or counterbore or other turret tool will hit the top of the forming tool post on the front slide. To overcome this, it was necessary to have the forming tool post as low as possible.

After trying several tool posts which we purchased, we decided to design one of our own—with the result shown. It gives clearance enough so that a 2-in. reamer can pass over it. It also gives a wide range of flat forming tools and will hold a number of cutoff tools. The peculiar way in which it is made allows the form or cutoff tool to get close up to the collet.

The cast-iron body *A* is shown in detail. *B* is a machine-steel cap that carries ½-in. hollow hexagon setscrews which hold the tools down. As we are not using all of these tools at once, the four ½-in. fillister-



TOOL POST FOR FLAT FORMING

head screws that hold the cap down will more than offset the strain put on these hollow hexagon setscrews. The wedge *C* is used to raise and lower the tools. Two

sets of wedges are shown in detail. These are to accommodate two different sizes of tool—5/8 in. and 7/8 in. thick. The way in which the block is fastened to the cross-slide on the left side may also be of interest. Owing to the fact that the block extends beyond the cross-slide, it was impossible to fasten the left side in the same way as the right, so we finally hit upon the wedge system shown.

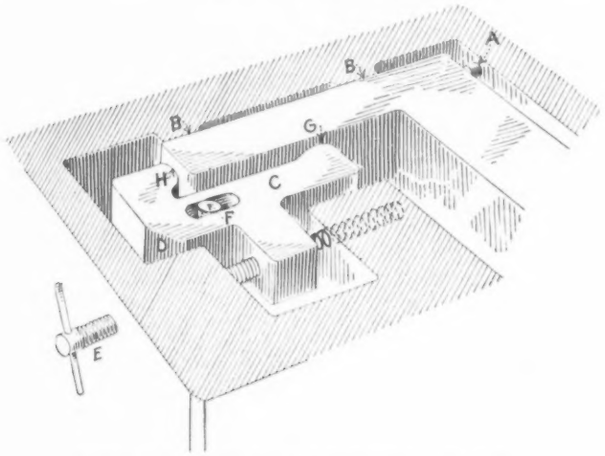
The tapped hole in the wedge *D* was put in so that it could be removed in case it stuck or roughed up; and it would not come loose of its own accord. The wedge is 5/8 in. in diameter and fits into a hole 21/32 in. in diameter, which allows the wedge to float back and forth, equalizing the pressure on each stud *E*.

After using this tool block for several months I heartily recommend it to anyone who has work that it is possible to form and drill simultaneously.

Dayton, Ohio. RAYMOND W. BECKMAN.

Single-Screw Two-Direction Jig Clamp

The accompanying sketch shows a method of clamping a piece in a drill jig, the idea being to clamp with a single screw against the stop pin *A* and against the surfaces *BB*, which are used to square up by. The clamp *C* is held



SINGLE-SCREW TWO-DIRECTION CLAMP

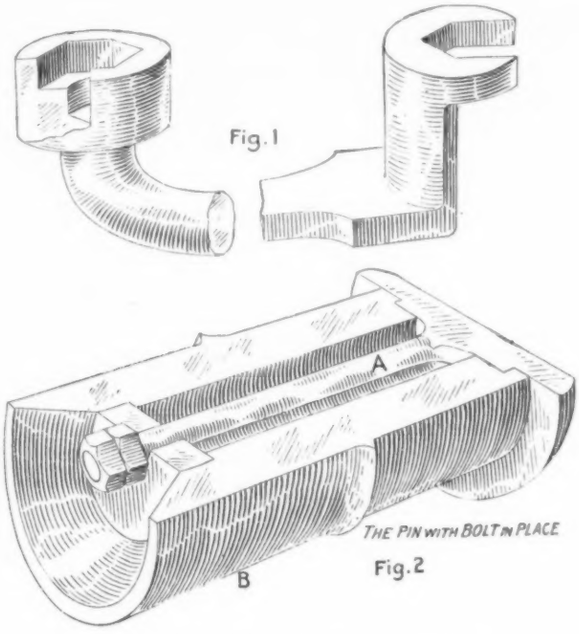
sidewise in a slot *D* in the jig body. As the screw *E* is tightened the clamp *C* swings around the pin *F* until it touches the work at *G*, when it slides on the pin *F* until it touches the work at *H*. A continued tightening gives a combination of both these actions at once. When the screw is loosened, the spring causes the clamp to return to its first position, leaving the piece clear to be withdrawn. It is necessary to exercise care in locating the pin *F*. OTIS R. WILLIAMS.

Hartford, Conn.

Wrenches for Crankpin Bolts

Fig. 1 shows a pair of wrenches for tightening nuts on the inside of crankpin collar bolts. In nearly all front driving wheels of locomotives the side rods are held on by a collar bolt, as at *A*, Fig. 2, which goes through the hollow crankpin *B* and is tightened from the inner side of the wheel. The only time it can be tightened is when the wheel is on the bottom quarter, as the frame and pedestal caps prevent getting at the nuts in any other position.

We formerly had to use a hammer and long chisel for this purpose; and it was not a pleasant job, inasmuch as the ends of crankpins are counterbored more or less. The two wrenches shown make the work much simpler



WRENCHES FOR CRANKPIN FLANGES

and save time. They are more satisfactory in every way, as they reach into the counterbore and handle the nuts easily. JOSEPH K. LONG.

Renovo, Penn.

Do You Use Dynamite?

An article recently appeared in the *American Machinist* regarding a method of removing die keys in drop hammers by means of dynamite. No doubt there are many concerns who would be glad to avail themselves of further information on this point, and I would like to hear from other readers of the *American Machinist* who have used dynamite for this purpose. CHARLES C. FOSTER.

Buffalo, N. Y.

Two Examples of Welding Work

The Laconia Car and Foundry Co., Laconia, N. H., uses the oxyacetylene torch for many cases of welding. In Fig. 1 is shown a frame field for an automobile starter that has been made on the bulldozer. The joint is then welded with the oxyacetylene torch, as shown in Fig. 2. One of the fields after welding is illustrated in Fig. 3. The apparatus used at this factory was made by the Waterhouse Co., Boston, Mass. The average time required to weld one of these frame fields is 5 min. With a No. 13 tip, the consumption of acetylene and oxygen gas is 2 ft. of each.

Some electric welding is also performed on various parts of car bodies. One example of this sort is seen in Fig. 4. The work is spot-welding the insulation clips on a monitor

FIG. 1. THE FRAME FIELD BEFORE WELDING

FIG. 2, WELDING THE FIELD

FIG. 3. THE WELDED FIELD

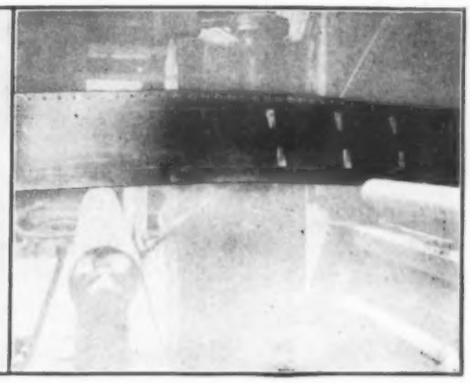


FIG. 4. SPOT-WELDING THE CLIPS

sheet. The machine used is a Toledo electric welder. In the illustration are shown six of these clips that have been welded on the sheet.

A. TOWLER.

New York City.

Tap and Body Size Drills for Counterbores

The table gives A.S.M.E. standards and special machine screws with the proper dimensions of body drills and sizes of counterbores for fillister-head screws and flat-head screws. I have experienced some trouble in getting the heads of screws well fitted in the pieces machined, according to the tables given in the different handbooks. I was successful in getting a good fit and also facilitated the work in the machine shop by having all the drawings made up according to this table, which was also furnished to the men in the shop.

PAUL HETCUYI.

New York City.

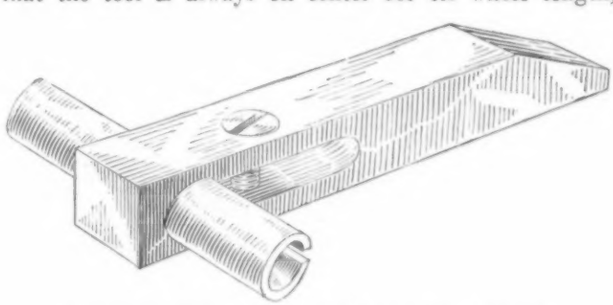
TAP DRILL, TAP AND BODY HOLE SIZES FOR A.S.M.E. STANDARD AND SPECIAL MACHINE SCREWS

Screw and Tap No.	Threads per Inch	Maximum Outside Diameter of Screw	Nearest Fraction of an Inch	Tap Drill	Body Drill "A" Loose Fit	Body Drill "A" Snug Fit	Fillister Head C	Fillister Head B	Flat Head C	Flat Head B
0	80	0.060	1/16	56	51	52	0.0376	3/32	0.029	0.112
1	72	0.073	5/64	53	48	49	0.0461	1/8	0.037	0.138
*1	64			54						
2	64	0.086	3/32	50	43	44	0.0548	5/32	0.045	0.164
*2	56			51						
3	56	0.099	7/64	46	39	40	0.0633	3/16	0.052	0.190
*3	48			47						
4	48	0.112		43	34	35	0.0719	7/32	0.060	0.216
*4	40			44						
*4	36			45						
5	44	0.125	1/8	38	29	30	0.0805	7/32	0.067	0.242
*5	40			39						
*5	36			40						
6	40	0.138	9/64	33	27	28	0.0890	1/4	0.075	0.262
*6	36			34						
*6	32			36						
7	36	0.151	5/32	31	23	24	0.0976	9/32	0.082	0.294
*7	32			31						
*7	30			32						
8	36	0.164	11/64	29	18	19	0.1062	9/32	0.090	0.320
*8	32			30						
*8	30			30						
9	32	0.177		26	15	16	0.1148	5/16	0.097	0.346
*9	30			27						
*9	24			29						
10	30	0.190	3/16	22	10	11	0.1234	11/32	0.105	0.372
*10	32			21						
*10	24			26						
12	28	0.216	7/32	15	1	2	0.1405	3/8	0.120	0.424
*12	24			17						
14	24	0.242	1/4	7	D	C	0.1577	13/32	0.135	0.472
*14	20			11						
16	22	0.268	17/64	2	J	I	0.1748	15/32	0.150	0.528
*16	20			3						
18	20	0.294	19/64	C	N	M	0.1920	1/2	0.164	0.580
*18	18			B						
20	20	0.320	5/16	H	Q	P	0.2092	9/16	0.179	0.632
*20	18			H						
22	18	0.346	11/32	J	T	S	0.2263	19/32	0.194	0.682
*22	16			K						
24	16	0.372	3/8	N	W	V	0.2435	21/32	0.209	0.732
*24	18			O						
26	16	0.398	25/64	Q	Z	Y	0.2606	11/16	0.224	0.788
*26	14			P						
28	14	0.424	27/64	S	7/16		0.2778	23/32	0.239	0.840
*28	16			T						
30	14	0.450	29/64	V	15/32		0.2950	3/4	0.254	0.892
*30	16			W						

*Special machine screws.

Boring-Tool Holder for a Bench Lathe

For boring small holes I constructed a tool holder, as shown, for use in a bench lathe. Its chief advantage is that the tool is always on center for its whole length,



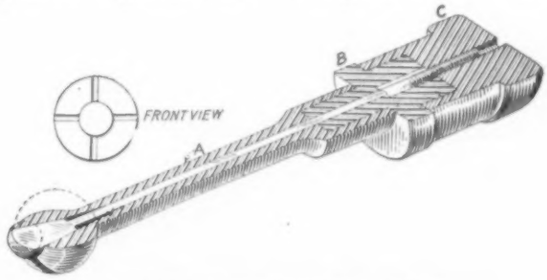
BORING-TOOL HOLDER FOR BENCH LATHE

unlike most boring-tool holders in a tool post with rocker, with the tail end below the center, so that continual adjustment is required to bore a hole of any depth.

Bridgeport, Conn. JAMES MCINTYRE.

Adjustable Internal Gage

The drawing shows a gage with fine adjustment for holes. *A* is of tool steel. The gage end is made as hard as possible to prevent wear. The parts *A* and *C* are an



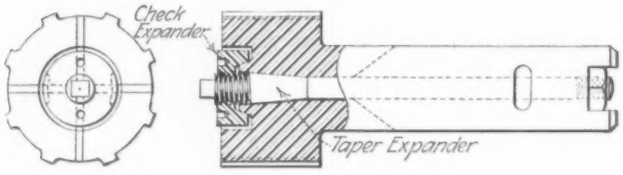
ADJUSTABLE INTERNAL GAGE

easy fit on *B*. This device would hardly be practical in quantity manufacturing, on account of the small bearing surface, but for a few holes, or where the gage is set frequently to the micrometer, it will be found handy.

Brooklyn, N. Y. GEORGE C. LAWRENCE.

Parallel Expanding Tap

Allow me to call your attention to a grave error in the sketch showing a parallel expanding tap, page 689, Vol. 14. The expander is threaded in the end below the taper



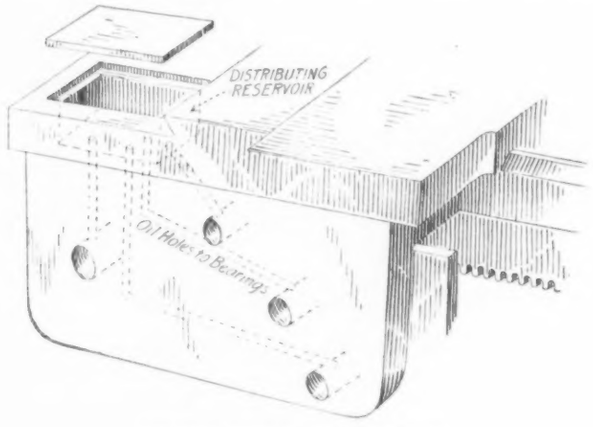
A PARALLEL EXPANDING TAP

engaging the check expander. These threads are not shown. The illustration herewith shows the tap correctly.

Kenosha, Wis. E. HAWKINSON.

Oiling the Lathe Apron

I make a point of oiling my lathe all over every Monday morning. The following five days I oil only the headstock spindle bearings. It has occurred to me that



OILING THE LATHE APRON

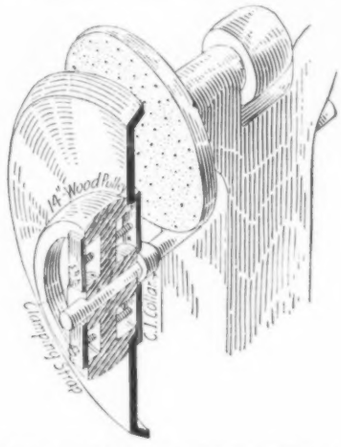
it would be a good plan to put an oil-distributing reservoir in the carriage, as shown in the sketch. It would cut out about ten individual oil holes on the carriage and prevent a man's forgetting any of the holes.

Wembley, England. J. H. DAVIS.

Grinding the Edges of Sheet-Steel Pans

That the disk grinder can often take jobs that would be done on the lathe is illustrated by the sketch of a simple rig for cleaning up the edge of a shallow cast-iron pan. The pan was 28 in. in diameter, had a 13-in. hole in the center, was 2 in. deep, and the metal was not over ⅜ in. thick. It was almost impossible to do the job in the lathe, as the metal was very hard. The edge of the pan fitted against a plate-glass disk and it was necessary that the surface be flat. The work was done on the disk grinder in the following manner:

A 14-in. wood pulley was placed on a mandrel and a fitting turned on one side. This fitting served to locate the casting. Four straps and bolts were used to hold the casting up against the pulley, and a cast-iron collar



GRINDING EDGES OF SHEET-METAL PANS

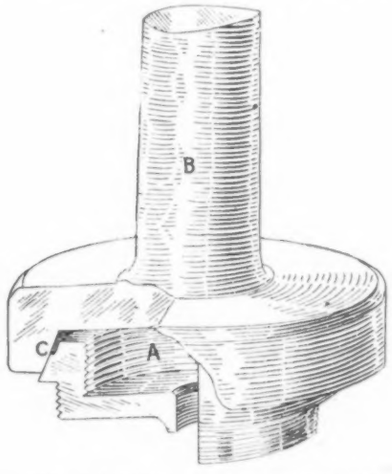
was placed on the disk-grinder shaft for the pulley hub to butt against. Grinding was kept up till the hub of the wooden pulley came in contact with the collar that had been fastened on the shaft. The entire lot of pans came out flat and all alike. WESLEY MCARDELL.

New York City.

Tool for Closing Fuse Sockets Tapped Oversize

The illustration shows a tool for contracting fuse sockets for 18-lb. shrapnel. If in machining the inside thread *A* of the fuse socket the tap cuts the thread diameter too large, the tool here shown can be used to correct this trouble, so the socket may be used. The tool *B* is made out of tool steel, hardened and tempered.

The angle *C* is made to conform with the angle of the fuse socket. After the latter is screwed into the shrapnel,



TOOL FOR CLOSING LARGE FUSE SOCKETS

the tool is placed over the socket, as shown. By hitting one or more blows on the top with a hand hammer, the inside diameter will close in evenly all around, thus saving the fuse socket. H. WATTS.

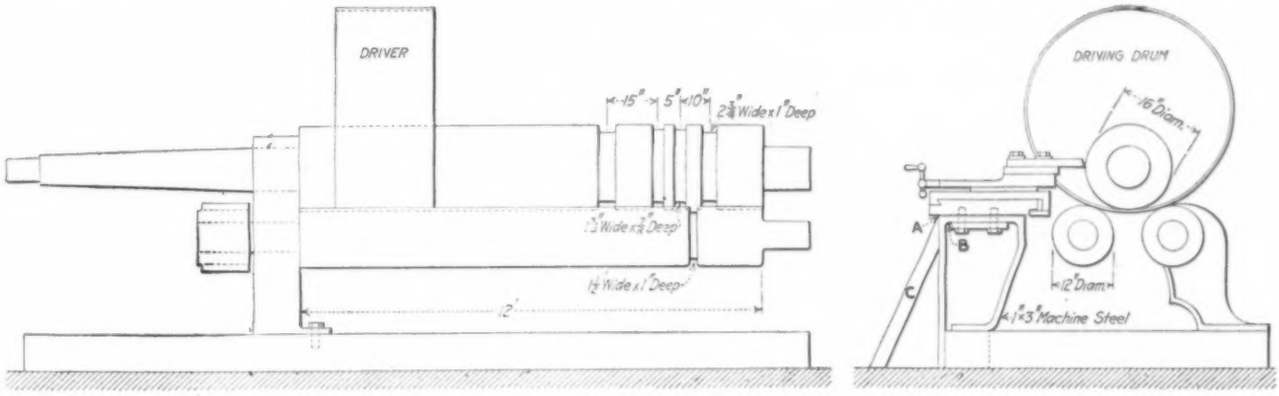
Turtle Creek, Penn.

Discussion of Previous Question

Cutting Downward in the Lathe

The editorial on page 255, Vol. 44, on the value of reversing the direction of rotation of a lathe when cutting off stock, calls to my mind a job we had to do about 12 months ago, which was successfully accomplished only after reversing the tool.

We had to prepare a set of 12-ft. boiler-plate rolls for rolling traction-engine wheels. It was necessary to put in the bottom rolls six grooves each and four in the top one. The job presented something of a problem. To take the rolls out was impossible, owing to lack of time. We decided to do the work in place, using the power of the machine as a driving medium.



CUTTING DOWNWARD IN THE LATHE

We took the cross-slide off a planer and set it up on two brackets that were bolted to the base of the machine, setting up for the top roll first. The brackets were finished on the faces *A* and *B*, and the strips were laid against the face *B*.

As only the bottom rolls were geared, the top one being merely a follower, the method of driving the top roll presented another difficulty. This problem was solved by placing a drum about 36 in. in diameter between the rolls and adjusting the top roll until the friction between the roll and the drum was sufficient to drive for the cut.

We first tried to drive in the usual way, with the work traveling toward the tool. Progress was extremely slow and the job poorly done. Whether the cut was light or heavy, the tool would dig in and chatter to an extent that made it appear impossible to get good results that way. We applied the brace *C* without improving things much.

When matters had reached this point, I thought of the European practice of reversing the tool and direction—a method I have seen used in English shops. After making that change, our troubles were over, for everything went right along. The tendency now was to pull the tool into the work, which only served to feed a little heavier, instead of driving it away from the work as in the first case. After the four grooves in the top roll were completed, the brackets were cut to the height necessary for the lower roll and the process repeated.

Mansfield, Ohio. R. A. WILLIAMSON.

Precision Gage-Making Work

Mr. Remacle's article, p. 635, Vol. 44, on precision gage making, together with a previous contribution regarding over-complicated gages, makes the following suggestions and drawings timely. Three points are brought out: Our system of calling for dimensions that permit the use of standard sizes of stock with minimum waste and the incorporation of conveniences for the user of the gage; a shining example of over-design, entailing useless work on the part of the tool maker; and a brief description of our methods of grinding and lapping limit gages of extreme accuracy.

While it may seem right to consider first the more conspicuous points, as shown in the drawing, still I think the order of discussion really should be as enumerated; so I will first take up the matter of system and design as we have successfully practiced it for some years. We design and build nearly all our own tools and gages, and we require a higher degree of accuracy than is usual even in this close work.

Considering Fig. 1, it will be seen that the general dimensions, as given, allow stock sizes of material to be used and finished to a certain size with very little waste. For illustration, the thickness of this particular gage is ⅛ in. minus 0.010 in., the 0.010 in. being allowed for surfacing and finishing. A similar idea is carried out as regards the width of these gages, while the length is merely specified as 2¾ in., since the length is not a stock size, but may be cut off the bar at any desired point.

This method of calling for stock assures that the gage, when finished, will be of a certain length, breadth and thickness, all of which is not only in keeping with high-grade workmanship, but produces a number of gages that, if of the same size, will be equally affected by temperature changes; and this plan also enables us to use

costly materials to the best advantage. Further than this, the system permits the designer to calculate stresses more accurately, for what is true of this simple gage is equally true of the most complicated jig or fixture.

Of course, I have heard of milling or planing off ¼ in. or so "to get below the scale," but I think that is more theoretical than practical—and this article is preëminently practical. Near the "Go" end of the gage a small hole is drilled for the convenience of the user. This enables the workman to locate the "Go" end almost instantly; and as he uses the gage more and more, the "Go" end is located simply by feeling. This is a detail that aids in rapid production.

It will be noticed that the gage is marked 17-8; this shows that the gage is used for operation No. 17 in de-

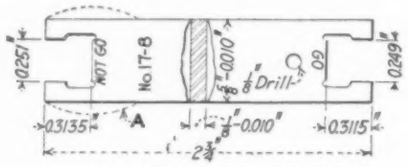


FIG. 1. TYPICAL GAGE

partment No. 8, in this case the milling department. The words "Go" and "Not Go" are etched in broad heavy letters. We have found that stamped letters soon become clogged with oil and dirt, and as the gage loses its brightness the words become difficult to read quickly. I shall continue to specify etched letters until a better method can be found. The portion shown in dotted lines at *A* is used only on large gages with forged body and welded contact surfaces.

So much for our system of design of small limit gages. Before taking up grinding, just a word about over-design. The depth dimensions, 0.3115 in. and 0.3135 in., should in my opinion never be used on a gage of this sort. I believe that these dimensions will be particularly difficult to work to and more especially so when unskilled labor is employed; besides, it is hardly to be exepcted that any two milling hands would get the same "feel" within the limits specified, for it is much more difficult to work accurately to a fixed depth gage than it is merely to caliper for width or thickness. Further than this, I am of the opinion that the frequent trying for depth will be very wearing on the jaws of the gage, all of which decreases the life of the gage and lowers production.

One of the rules we have in the tool-grinding department is, Never grind anything with the side of the grinding wheel, for no wheel will produce work truer than itself. I noticed that Mr. Remacle used a plain straight-side grinding wheel. Now I contend that in this case the corners will wear away almost at once; then as the wheel is passed through the slot in the gage, the side of the wheel, being better supported, will grind more than will the part of the wheel nearer its periphery.

Do what you will, you will still have a tapered slot, for while both the edge and a point varying in distance from the edge will grind at the beginning of the slot, only the edge will reach the greatest depth of the slot, or farthest point of travel of the wheel. Therefore, while the wheel is being passed into the slot, the front end of the slot is being ground constantly, which is not the case with the rear end of the slot. Consequently, the part of the slot nearest the center of the grinding wheel will be the largest, and this is so regardless of the position of the gage being ground. Again, since the side of a grinding wheel hardly ever runs true and cannot be trued up so that it will continue to run true, the inside of the slot will be wavy, the degree of waviness depending upon the feed used. With the utmost care, all this will mean a lot of unnecessary lapping; with any less care, it would probably mean a spoiled gage.

In setting up a gage for machining, simplicity should be the keynote, for the amount of possible error is in proportion to the number of setting surfaces. When two angle plates are used, there are three surfaces, each one to some extent incorrect. There is the surface between the machine table and the first angle plate; second is the surface between the two angle plates; and third is the surface between the second angle plate and the gage. The only way to reduce the possible error is to reduce the number of setting surfaces. This is where the magnetic chuck is to be recommended.

In Fig. 2 is shown our way of doing the very same work described by Mr. Remacle. We use a No. 2 Brown & Sharpe surface grinder, equipped with a magnetic chuck, for all the operation on this gage. A ground parallel block is set on the chuck and the gage held to this by a clamp, as shown, the gage being held down squarely on the chuck by magnetism.

In setting the gage true, one of several methods may be used. In Fig. 2 the approximate setting line *E* is

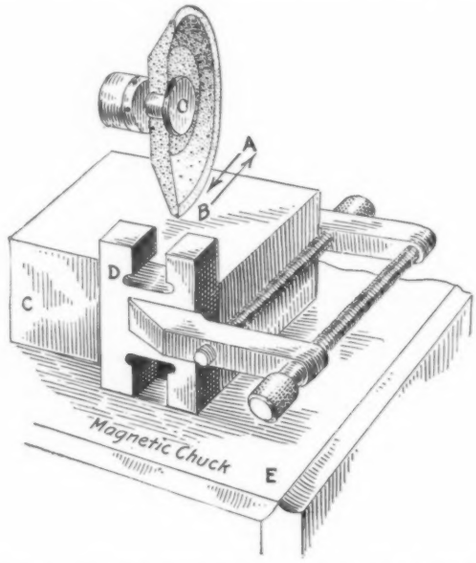


FIG. 2. SETUP FOR GRINDING A SNAP GAGE

scribed by removing the grinding wheel and fixing a scriber to the spindle; then the head is lowered and the table moved inward (or outward) by means of the cross-feed screw. This gives a line convenient to set the parallel block, or gage, to, but it is only a rather crude approximation, at best. Properly, the parallel block should be lined up by means of an indicator clamped to the wheel spindle, trying first at one end of the parallel then at the other, the tool maker remembering meantime that nothing but "dead true" is "good enough."

A dished wheel is used, and the small grinding edge shown passes clear through the gage slot. This wheel may be dressed down to grind in a ¼-in. slot. In grinding a narrower slot, say $\frac{1}{16}$ in., a grinding wheel $\frac{1}{16}$ in.

thick is used and side clearance dressed with a diamond, or even with a carborundum brick. In all cases one side of the gage slot is ground at a time, removing approximately one-half the stock, while the remainder of the stock is ground from the other side. The gage should not be removed from the clamp and turned around under any circumstances, but the dished wheel should be turned so the concave side will be to the cut, or toward the side of the slot being ground.

This method enables the gage to be readily ground to within a "short tenth," then lapped, either in the same machine and at the same setting, using a charged metal lap, or at the vise. In Fig. 2 the direction of the wheel movement is indicated by the arrows *A* and *B*. The chucking parallel block is shown at *C*. The gage being ground is shown at *D*, and *E* is a "setting" line.

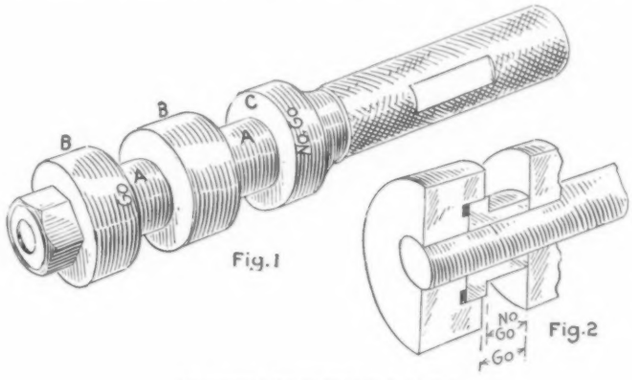
Plainfield, N. J. J. B. MURPHY.

[We never heard of "milling or planing off ¼ in. * * * * to get below the *scale*" of tool steel, but we know from "practical" experience that it is often necessary to remove as much as ⅛ in. from annealed tool steel to get below the decarbonized surface.—Editor.]

Adjustable Snap Gage

I refer to Mr. Henry's article on the adjustable snap gage, page 933, Vol. 44. While all he has to say about this tool is true, the design may be changed to good advantage without altering the principle—namely, the use of space blocks.

The gage shown in Fig. 1 possesses all the good features mentioned in Mr. Henry's article. Also, as the disks *B* are 2 in. in diameter, there is 6 in. of gaging surface to be worn before it becomes necessary to repair the gage,



ADJUSTABLE SNAP GAGES

which is also easy to handle. The operator may either hold it in one hand by the knurled handle or use it while it is lying on the bench, in which position it always presents a gaging surface to the operator.

While the initial cost of this gage may be slightly in excess of others, it will pay in the long run. The large extent of gaging surface will allow the gage to be used for a long time without repairs. If the sizes become obsolete, the various parts will serve to construct a gage with other sizes by substituting other space blocks *A*. It is essential that the greatest care be exercised in lapping these spacing blocks, or bushings, *A*, as any error in parallelism will be increased at the edges of the disks *B*.

Fig. 2 shows how the gage may be designed to permit rapid gaging, also how a gage of the dimensions in Fig. 1 may be used to gage two different dimensions of a piece. If a rectangular piece is to be tested for three sizes, the disks and space blocks, as in Fig. 2, may be mounted on an arbor and secured with a nut. This arbor, which is centered at the ends, should be permitted to revolve upon centers mounted on a cast-iron base.

Newark, N. J. GUSTAVE A. REMACLE.

Oil-Ring Difficulties

Answering Mr. Wolf's criticism, page 914, Vol. 44, of my article, I do not believe that he fully appreciates the conditions as they existed in my case. The job was done about ten years ago, when I was an apprentice in a small job and repair shop back in the foothills, where it is usually difficult to find new and uptodate equipment, as it would not always pay.

I agree that one of the most important things in a shop is to have all machines in good working order, which would have prevented the loose spindle of the drill. But it was rather hard to keep things up in that shop, as the machinery was all old and should have been in the scrap heap. I remember one lathe in particular that had been through a fire forty years before; and the rest of the machines had been purchased shortly after, so they were not in the best of condition.

Mr. Wolf's method is far superior to mine from a manufacturing standpoint, but for the small number of rings that I had to make, my method was satisfactory and about the only way out. The rings were also strong enough, as the threaded bushings would not pull out or split the ring before the screws, which were the weakest link, gave way. JAROLD E. GREENE.

Ilion, N. Y.

Successful Suggestion Plan

I have read and reread W. J. Tewksbury's article on page 815, Vol. 44, and have come to the conclusion that the title he has chosen for the article is a particularly apt one from his, but not from the suggestor's, point of view.

On analysis the successful suggestion plan simmers down to this: The employees are prodded with every kind of goad that the management can devise. These incentives run the gamut of printed lead pencils, gentle reminders (Fig. 4), blotters (Figs. 6 and 7), time cards (Fig. 8) and calendars (Figs. 9, 10 and 11). These latter we are told are "blue or brown prints." It is reasonable to assume that they are made by the works drafting department. If so, is it not possible that the large zero in Fig. 11 is a subtle bit of irony on the part of the designer, inferring the suggestor's reward?

The last subhead reads "Assuring a Square Deal." To appreciate this thoroughly, let us "balance the books" of the suggestor and the concern. In column 2, page 817, we see that one suggestion netted the firm "$6,700 in a single year." This is 6 per cent, on over $110,000. "We have had several instances where the total value of all the suggestions made by one employee reached $1,000 or more." Obviously there are many suggestions individually of less value than these, but probably representing in the aggregate a respectable sum.

Now what are the rewards? These vary in value from a meal ticket to "a 21-jewel gold watch." In between

the high and low are many items, including diamond rings that are miniatures of the company's product. Wearing these makes the proud possessor a perpetual sandwich man or woman carrying the firm's advertisement.

Gold watches with 21 jewels can be bought for $40 or $50 each; with filled cases, from $20 to $25 each. I assume that the author of the $6,700 suggestion was given a watch (which he may not have wanted) costing a little over one-half of 1 per cent. on $6,700, the annual value of his suggestion, and roughly five-hundredths of 1 per cent. on the estimated value of the suggestion. I, for one, fail to see the square deal. J. WATT.

New York City.

Wasted Intervals in Small Shop

An article on reducing wasted time intervals, accompanied by some suggestions, is given on page 1069, Vol. 44. There are a few of those suggestions that should be used most cautiously or there will be disappointment.

The writer had a few years' experience under scientific management experts who made exhaustless efforts to cure some of the mentioned intervals—with partial successes and flat failures. During this period there was much cleansing and substitution of labor. The shops under consideration were contract shops and required all-around talent.

Take the centering operation for instance: In this shop many shafts were made, some square with journals in three places, others rough-turned forgings. The usual allowance was ⅛ in. over all on diameters. Now the usual custom had been to let the machinist do his own centering. Under the new management boys and laborers were given the centering operation, the machinist only laying out and marking with a center punch. Here were the results: One piece in ten would be true to dimension, centers were drilled all depths, center drills were broken, center axes were not parallel. I have seen 40c. men spend several hours trying to fix up poor centering of 20c. men. Such things would not be tolerated in a jobbing or repair shop. Rapid and accurate work can only be done by careful centering. There is nothing that will disgust a good lathe hand more than poor centering.

Regarding the abuse of small tools such as drills, reamers, etc., those in authority are more to blame than those who use them. I know of several shops that have bulletins posted in conspicuous places about the plant stating the approximate price of each small tool. Yet these very same owners are always jollying their drillers, especially the apprentices, by saying, "Don't be afraid of the drills, boys. If they break get another one. They are bought to be used up." The best system I ever came across for economy of small tools was in a woodworking machine-tool shop. Here every driller had his own outfit of drills, etc., in a cupboard under lock and key, the tool-room only making replacement of broken tools or giving out odd-size tools. Wages were based to a certain extent on this saving also.

Detailed minute instructions to repair- or jobbing-shop mechanics is the surest way to disappoint them. A foreman, no matter how good a workman he has been, after holding a foreman's position a few years gets out of practice. His duty is to steer and guide; to curb the strong and protect the weak—by the weak I mean apprentices, or learners—from the outrages of the stronger fraternity. A careful and conscientious workman after a certain amount of discipline should be allowed to use his own judgment, for during this period he had got an idea of what his superior wants. It is said that contentment is half of life. This applies equally to jobbing and repair shops.

It is the Graces that win here, not minute instructions or elaborate cost systems. The jobbing- or repair-shop foreman who cannot make life pleasant and interesting without minute instructions has mistaken his profession and will fail. G. STROM.

Brooklyn, N. Y.

[Mr. Strom has evidently missed the real application of some of the suggestions in the article he refers to, but his comments on shop conditions and limitations are interesting.—Editor.]

Sponges That Only Absorb

On page 960, Vol. 44, Mr. Little writes: "One of the greatest pleasures in life is telling the other fellow how you did it," etc. I don't think Mr. Little has ever worked in a Kenosha, Wis., factory; he gives his address as Rochester, Minn. From the tone of his letter I am inclined to think his home is in heaven.

Some thirty-five years ago I began to learn the trade of pattern making. I started out on the lines suggested by Mr. Little, always willing and anxious to listen to and learn from the old journeymen. When I grew to manhood it "gave me great pleasure to tell the other fellow how I did it." That was thirty years ago; things have changed.

Today we have in every shop the wise young man mechanic. To undertake to tell him anything would be a waste of wind and time. Then we have the "plug" mechanic, the fellow who never reads, listens, or thinks, who knows the location of every saloon in the town, who can tell you at which end of the bar the free lunch is.

Standing at the bar, with a pig's knuckle in one hand and a glass of beer in the other, he can tell the other fellow more of that how-he-did-it stuff in five minutes than a regiment could absorb in a week. Mechanics of this class don't care to listen to anything that is elevating, broadening, improving.

After spending thirty-five years—divided up in the pattern shop, machine shop and the foundry—working with all kinds and classes of mechanics, I am convinced that the best plan to follow when you have anything worth telling to the other fellow is to send it to the editor of the *American Machinist*. If it has merit it will be published where every reader of the *American Machinist* will see it and profit by your experience.

Quoting from Mr. Little's article: "Help the other fellow and bring back to yourself information that you would not otherwise receive." I am led to believe, after reading Mr. Little's article, that his experience has been limited to shops employing only first-class mechanics. Such men always welcome from a brother mechanic how he thought out some little kink or saved time in doing a job. Not so with the "plug" mechanic. To tell him anything would be an invitation for slurs and sarcasm. Don't tell it to the other fellow. Tell it to the editor.

Kenosha, Wis. M. E. DUGGAN.

Editorials

Why Not Same Hours for Office, Drawing Room and Shop?

Is not the principal cause of the suspicion and antagonism that exist among the office, drawing room and shop the special privileges given to the two former? Measured by shop standards, the office help come in late and go out early; in many places they do not have to punch the clock; in most places they are paid a salary and are not docked for tardiness or short absences and have a vacation with pay; no record is kept of how much work each one does; they have free use of the telephone, office stationery and numerous other small advantages. Measured by shop standards, the drawing-room help also have certain special privileges, the most important of which are short hours, vacations with pay, and no docking for lost time. It would be interesting to inquire into the origin of these special privileges, but space does not warrant such a discussion.

From the viewpoint of simple justice the question must be asked, Why should special privileges be accorded to the office and drawing room? Or striking more directly at the most important privilege, Why should not the shop, office and drawing room work the same hours?

This question has peculiar force at this time for the reason that there is a tendency all over the country to shorten the working hours in shops and factories. Thus an opportunity exists to hold the office and drawing-room hours where they now are and shorten the shop hours until they are equal or nearly equal to those worked in the other places. The best condition might be to have the shop and office hours identical, although in some cases it may be more practical to make them equal for the week rather than coincide for each day. Is it not possible to find substantial reasons for such a course?

If this course is carried to its proper and logical conclusion, all heads of departments should report at the same time that their employees enter the works. Everyone should get his weekly wages in an envelope the same as all others. In other words, no one should draw a "salary."

Some points in favor of this general suggestion have been sent to the *American Machinist* by a manufacturer who has had many years' experience in handling several hundred employees. At his request we are not revealing his name. He sums up his beliefs under seven heads, as follows:

1. The one big reason is the economic one. In the olden days the office force amounted to one or two people. It was relatively very small and humble. With better organization and better management, the office force has become relatively larger and larger and is today a big factor in costs. It is nonproductive. Now, then, all of our emphasis for the last ten years has been in connection with reducing the cost in the factory, and we have not given the proper consideration to the problem of the office.

2. We believe that almost all labor troubles arise from this feeling of privilege. We believe that one of the biggest objects an industry should set before itself is to abolish privilege wherever it exists and to the very utmost. The concern that succeeds in removing from its employees the feeling that privileges are granted to anyone is on a better basis than when conditions are otherwise.

3. As a matter of truthful fact the office force does not have to work nearly as hard as do the people in the factory. On the basis of real justice it is unfair that they should have shorter hours.

4. Obviously, what we propose will tend strongly to break down a fictitious class distinction. Office hours and factory hours once on the same basis, we will transfer people readily from the office to the factory and vice versa.

5. The same working hours naturally lead to social intercourse between factory and office employees.

6. It emphasizes very strongly that the company wants to deal with all of its employees justly and to deal with them as a whole.

7. It is certain to develop a greater feeling of democracy in the organization.

Aeroplane-Propeller Problems

One of the most serious problems of aëroplane engineering today is that of the propeller. The laminated wood propellers used on the small machines with motors of 100 hp. or under gave practically no trouble. But with the increase in motive power up to 130 and 160 hp. and higher, propeller failures became much more frequent.

With aëroplanes of the pusher type, an accident to the propeller is almost sure to be serious as it is practically certain to cut the control wires even if it does not seriously damage the plane itself. With the propeller in front, as in the tractor type, this danger is almost eliminated, as the broken piece usually pulls itself ahead of the machine and falls clear of the planes.

There are different theories as to the causes for the failure of large propellers. One blames the jar due to the succession of blows from the explosion in the motor. These constant hammer blows are credited with causing fatigue if the wood fibers near the hub, resulting in the fractures at this point. This contention is based on the supposition of a constant succession of retardations and accelerations that stress the fibers at the fixed end of the lever arm.

The other theory, and one that seems to be more tenable, is that the stresses come from the leverage exerted by the tremendous power of the motor practically prying against the air at all times. The blades can be seen to deflect, as would be expected, and this stress continued finally strains the fiber near the hub and cracks develop. These can usually be discovered before breakage occurs, unless the flight is continued too long, although propellers on high-powered motors have failed after two hours of service.

As the flexing of the blade between the hub and the tip cannot be prevented, for there is a tremendous force exerted on a long leverage, the solution seems to lie in the

direction of stronger and better material. Steel, aside from its added weight, is said to become fatigued in a very short time and give way to the flexing action, and so far nothing has been found so satisfactory as wood.

Another factor, which is not always considered as carefully as it should be, is the perfect balancing of the propeller. Static balance is not enough, and yet the running balance involves a number of interesting questions, among them the problem of balancing with both blades flexed by the push against the air. This is aggravated by the two blades flexing a different amount, owing to the difference in stiffness between the two.

Whatever the solution, and the type of propeller is not here considered, the propeller is one of the many interesting problems before the aëronautical engineer at present, and he is not likely to run out of work for some time to come.

Are You Keeping Step in the Shop?

Why is the tramp of marching men and the cleancut stepping of their ranks so inspiring? No such feeling is raised by a moving crowd of people, even though they may be massed together and proceeding in the same direction. But let a company of soldiers march along a busy street on some day—say Saturday afternoon—when the sidewalks are filled with people, and everyone will stop and watch the swinging stride of the men in uniform. That small group of soldiers arouses emotions that the crowd never can.

Perhaps one reason for this is the common purpose shared by each of the marching men. They are going to the same place, at the same time and in perfect order. They are obeying definite commands. Each is doing his full share toward a common result. Taken as a body, they present an example of perfect coöperation acting under military discipline. The expression of that purpose the crowd sees by the keeping in step.

Is it possible to arouse a similar enthusiasm in the shop? Is it possible to so get a shop organization working together with a close coöperation and striving for the same goal so that one may truly say "that shop is keeping in step"? Of course the shop cannot present the inspiring sight given by the marching men. But under the best conditions the spirit actuating the soldiers can also grip and carry forward the workmen.

The Proposed Tax on Copper

The *American Machinist* reprints the following editorial for its sister technical publication, the *Engineering and Mining Journal*, and heartily supports the criticism of the class legislation that is under attack:

In commenting last week upon the proposed Federal tax on copper, we did not have the text of the measure before us and therefore had to be cautious. It was inconceivable to us at that time that copper alone among the metals should be taxed, yet mention of no other was made in the press dispatches. However, they prove to be correct. Out of the entire long list of crude commodities copper is singled for special taxation!

That Congress should have such a conception is dumfounding. Why copper and why not iron, lead, zinc and the rest? Why not coal and petroleum? Why not wool, leather, wheat, corn and cotton? The one thing that badly stands out is the unfairness of this project. Here we have class legislation with a vengeance. Copper producers are right in standing aghast at the enormity of the idea.

But this is not the worst of it. The proposed act reads, "Every person smelting copper ore, refining metallic copper or alloying copper shall pay . . . an excise tax . . . (on) the gross receipts . . . from the sale or disposition of refined copper or copper alloys and from the sale or disposition of crude or unrefined copper if sold or disposed of for any purpose except for refining or alloying."

We interpret this as meaning that the miner does not have to pay anything unless he smelts and refines. The smelter does not have to pay anything unless he sells his pig copper for casting purposes. The refiner has to pay (of course he will throw back upon the smelter) and the brass maker has to pay again for the refined copper that he uses. If the profit be less than 10 per cent., nobody has to pay. This lets out the careless, little fellow. Of course it is only the small class of big fellows at whom Congress in its present spirit is aiming. The thing is bungling and monstrous.

Alas! Class legislation is the governing idea in the new revenue bill as a whole. The income tax is doubled in rate without there being any reduction in the exemption limit. This tax is thus kept distinctly as a class tax. It falls upon a very small percentage of the population of the country and chiefly upon the people of a few states. The proposed tax on copper is even more narrowly limited. There is talk among the producers of spreading it among consumers generally, but how is that going to be done when half of our copper production must be sold in foreign markets in competition with the copper of the rest of the world?

We find no fault with the principle that taxes must be raised. We advocate military preparedness and that is going to cost money, which must be supplied by the people, but let them do it on a basis of equality. We do find fault with plans for unequal taxation, for class taxation, that are made the cloak for all kinds of governmental extravagance. We grumble about a tax on copper to provide money to build marble post offices in Yahoo and shack-towns and to dredge creeks in the prairies. We object to the expenditure of public money to maintain and aggrandize the jobberies—the bureaus—in Washington that spend vast sums to prepare bulletins to print the mouthings of quasi statesmen.

Now that Congress has learned how easy it is not only to spend other people's money, but also to get it, how long is it going to be before the income tax is quintupled and a tax on copper is levied and quadrupled? And what is going to be the economic result if the earnings of profitable industry be sucked away to be wasted?

This copper tax may not be felt so keenly when copper is above 20c. as it will at the normal of about 15c. and under. Consider a producer whose cost is 12c. and whose output is 67,000,000 lb. at 15c. Gross output, $10,050,000; net output, $2,010,000; excise tax, $191,500; rate, 9½ per cent. When the price for copper gets down to 14c., the determination of the 10 per cent. profit under the clause that grants exemption will begin to be interesting.

Shop Equipment News

Universal Machine for Small Shop

The different set-ups here shown are all variations in the setting or attachments of the same type of machine. This machine was designed and built by the J. L. Kunz Machinery Co., Milwaukee, Wis., for use in small shops where the amount of one kind of work is not sufficient to warrant the purchase of several single-purpose machines.

In Fig. 1 the machine is shown set up as a miller, with a dividing head on the table. It will be noted that the table is easily removable, for the use of special attachments, and it is also easily adjusted up or down the column for different sizes of work. In this case a large, split wood pulley is used directly on the cutter spindle, though in other cases an iron pulley is used. Power feed is available from a train of gears attached to the spindle mechanism. The power feed is conveyed from the gears at the front by means of a belt to the drive at the rear. The use of this belt allows slippage in case anything catches, and prevents damaging the machine. Hand feed is available from the handwheel at the back. The vertical feed has a movement of 2 in., both power and hand. In the set-up shown, a hand lever is connected to the slide so as to convert the machine into a quick-movement hand miller. The entire top of the machine may be removed from the

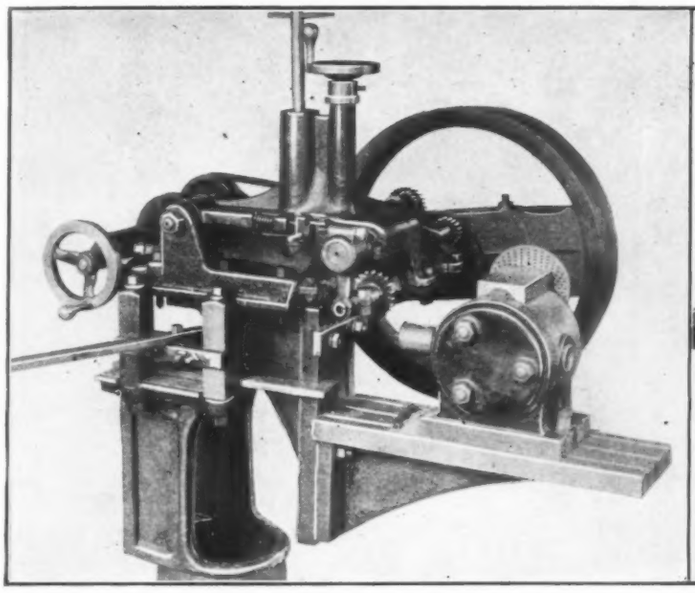


FIG. 1. UNIVERSAL MACHINE TOOL ADAPTED FOR SMALL SHOP APPLICATION

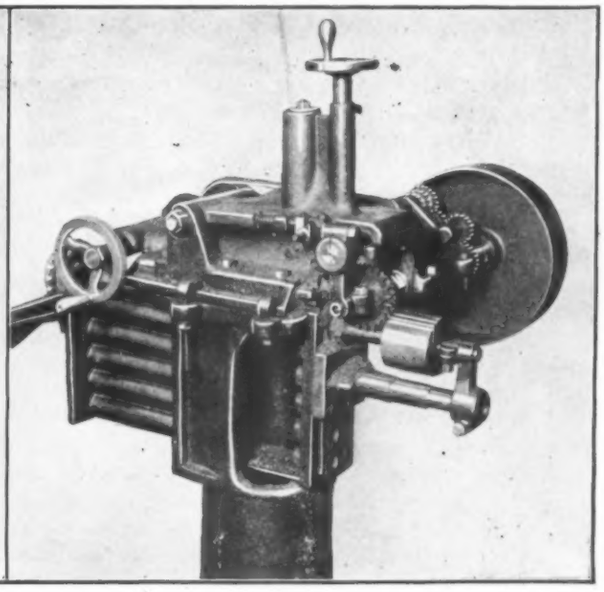


FIG. 2. MACHINE WITH GEAR-CUTTING ATTACHMENT

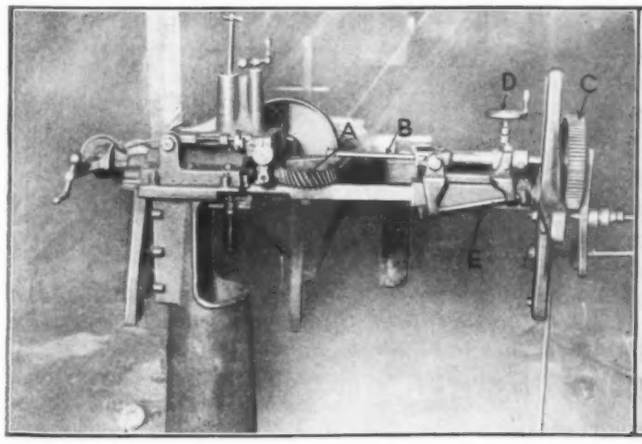


FIG. 3. THE KEYSEATING ATTACHMENT IN PLACE ON UNIVERSAL MACHINE

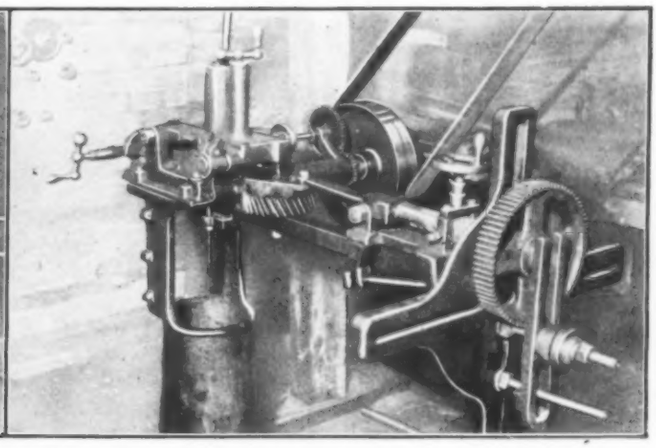


FIG. 4. ANOTHER VIEW OF KEYSEATING MECHANISM SET UP ON UNIVERSAL TOOL

stand and used for emergency work in almost any position. A feature worth noting is that the feed drive is always in line with the cut, making it possible to take a heavier and steadier cut with this machine than usual with a machine anywhere near its weight. The machine on its base is 4 ft. 8 in. high, and weighs about 650 lb., though this weight varies considerably according to the attachments used.

The machine set up as a gear cutter, or for other work of that kind, is shown in Fig. 2. The work shown on the arbor is a wood planer head, and the slots for the blades are being milled. The bracket holding the work arbor may be placed in six different positions, according to the holes in the holder that is placed under the upper part of the machine. These holes are so placed, that, with the vertical travel of the head, all center distances within the capacity of the machine are available. The arbor spindle extends entirely through one of these locating holes to the back of the machine, where a notched index plate is used to get the tooth spacing needed.

The attachment used for cutting keyseats is shown in Fig. 3. The keyseating mechanism is carried on a heavy bar clamped underneath the head of the machine and supported by a foot at the outer end. A V-groove runs the entire length under the head, and it is into this groove that the bar is clamped. This groove also makes it convenient for clamping the machine head onto a shaft for cutting special keyways, or special milling work may be clamped in it if needed. A worm is placed on the cutter spindle, and this drives a spiral gear *A*. This spiral gear is also an adjustable crank disk, to which is attached the connecting-rod *B*, fastened to the tool slide. The gear to be keyseated is clamped at *C* and the tool carrier works through the hole in the hub. The cutting tool is fed by means of the handwheel *D*. Relief on the return stroke is obtained by means of the slide *E*. Another view of this attachment is shown in Fig. 4, and will give a clearer idea of some of the details.

Automatic Duplex Slotter

The duplex slotter shown is fully automatic, it only being necessary to put in the piece, and the machine will do the work without further attention, and stop cutting when it is finished. Working from both sides at once, the time is cut in two, or two separate pieces are handled at one time automatically.

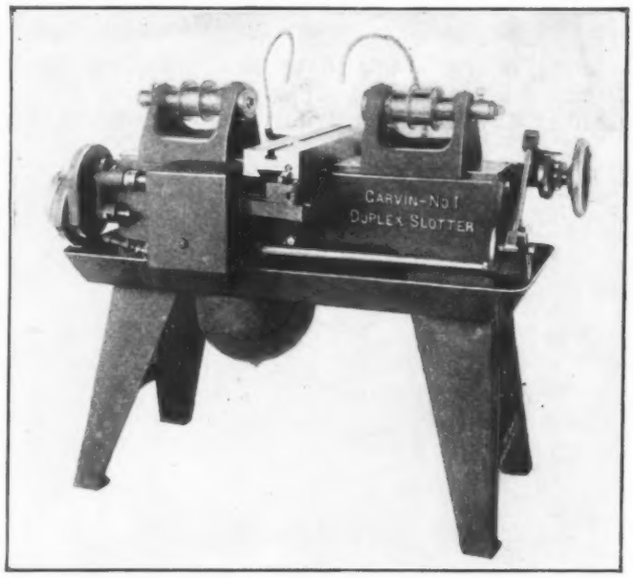
The work table is moved back and forth at uniform speed by cam and adjustable lever, which can be conveniently and quickly set to any length of stroke within the capacity of the machine. Cone pulley and change gears provide changes of speed to suit different conditions, short slots being reciprocated quickly and longer slots more slowly. The cam has a large size groove and hardened roller, and is driven by worm gear, and both cam and driving gears are well protected.

The spindle heads are designed for high speed, and the spindles are tapered at both ends and run in solid bronze boxes, provided with adjustment for wear and taking thrust on hardened step. Taper gibs are provided for the headstocks and work slide. The heads are fed in to cut automatically and simultaneously by right- and left-hand quick pitch screw, controlled by a ratchet wheel.

In milling a through slot, automatic provision is made to back away one head when the slot is almost through, so that the other head can continue to advance and complete the slot, leaving no partition in the bottom, and requiring no special attention.

The feed by pawl and ratchet is adjustable, and can be set to automatically lift out and stop feeding when the required depth of cut is reached. Feeding takes place at each end of the stroke.

Each head is independently adjustable along the bed to suit different lengths and conditions of cutters, position



AUTOMATIC DUPLEX SLOTTER

Capacity, milled slots from ¼ to 4 in. long; ¼ to 1½ in. wide clear through work up to 4 in. in diameter or 2 in. on a side

of the work on the table, etc. The headstocks are moved in and out simultaneously by handwheel and to any distance without interfering with the setting of the machine.

Work can be set at any angle on the table to produce a taper end of slot. Two prong fish-tail cutters are used. Adjustable fixtures to hold round work can be provided.

Changes of speed for different sizes of cutters are provided by a friction cone pulley on the countershaft. The spindle pulleys are driven by drums on the countershaft.

The machine is a recent product of the Garvin Machine Co., New York City.

Copper-Band Turning Machine

In the illustration is shown the latest addition to the line of shell copper-band turning machines made by the Jenckes Machine Co., Ltd., Sherbrooke, Canada.

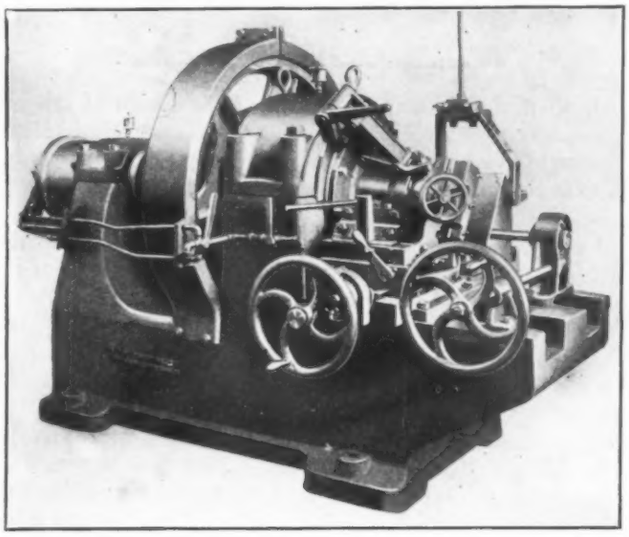
This machine has been proportioned to make it adapted for turning and finishing the bands on 12-in. shells.

The main spindle bearings are cast integral with the bed. The spindle is a heavy casting, finished by turning on the outside and boring the inside and finally finished on dead centers by grinding. The shell is held in this spindle by a collet-type chuck. This chuck is controlled by an air cylinder at the rear of the spindle and the jaws are positively closed or opened by means of a four-way valve.

The drive of this machine is through a heavy backshaft and cut gearing. An air clutch pulley is provided on this

shaft. This clutch is of the taper type with cork inserts, and is controlled by means of an air cylinder and three-way valve located near the operator's stand. Springs under compression release the clutch when the air is turned off. The tool arrangement for this work is massive. The main slide casting is bolted to the base by means of six studs and is not adjustable.

The rough shaping of the band is accomplished by means of two formed tools of high-speed steel. Each of the tools is held in dove-tailed fits in the steel tool block by two taper head bolts. Both tools are further supported



SHELL COPPER-BAND TURNING MACHINE

Capacity, 12-in. shells; front spindle bearing, 16 in. in diameter, 14 in. long; ratio of back gearing, 4½ to 1; drive pulley, 20½ in. in diameter, 13 in. face

by means of an adjustable jack so that the clamping effect of either tool helps to hold the other, and permits removing and replacing the tools with precision, after grinding. Each tool cuts approximately one-half of the band width. The tool block has a quick and convenient shift sidewise by means of a rack and pinion and is located accurately by a single stop rod and lock nuts. An accurate method of determining the depth of the cut is provided by means of a graduated dial and two adjustable pins, which can be screwed in or out, and which show flush with the face of the feedscrew housing when that tool has approached the depth of the cut. The exact depth is determined, however, by means of a pointer and the adjustable dial which makes it possible for the operator to hold the cut within close limits. The undercutting operation is by means of a separate tool and block mounted on the main or roughing tool block. This is in line with the undercut when the tool nearest the base of the shell has finished its cut, and has been slightly withdrawn.

The band is finally finished by means of a shaving tool which is arranged to feed down an incline block at the rear of the shell. This block is slightly adjustable to or from the shell, and means are also provided to rotate this block slightly to vary the diameters of the band at either end. The feed of this tool is through rack and pinion on the block and thence through worm and gear to the handwheel at the front of the machine at the operator's right hand.

The shell is located in the chuck by means of a swing stop attached to the cap above the spindle. This stop swings down and is locked in position by means of a toggle lever, and the shell pulled back until the band bears against the stop, after which the operator turns on the air to close chuck, swings the stop up out of the way, turns the air on the clutch pulley which starts the machine, and proceeds to feed in the roughing tools.

Cold-Metal Sawing Machine

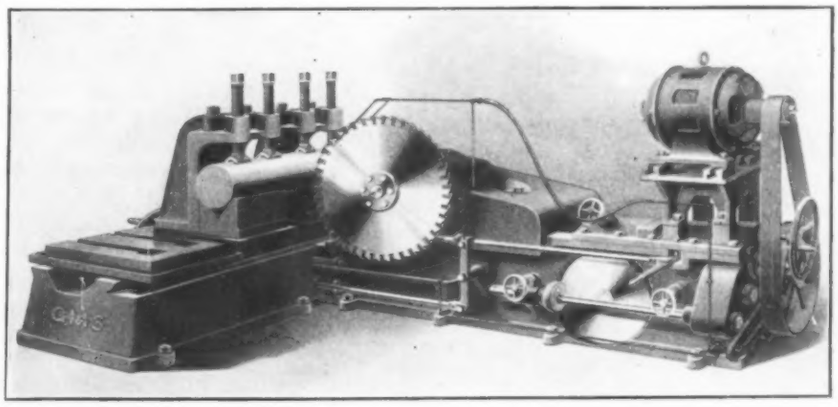
The illustration shows a cold-metal sawing machine marketed by the Vulcan Engineering Sales Co., Chicago, Ill. The saw arbor is of 60-point carbon hammered open-hearth steel, and has two driving gears formed integral with it. These gears are the same diameter and are situated close together. Their teeth are staggered by the amount of half their pitch. These gears are driven by pinions similarly formed on an intermediate shaft. The object of staggering the teeth of the gears and pinions is to reduce chatter. The saw arbor runs in hard bronze bearings.

The intermediate shaft is driven by worm and wormwheel. The worm is of hardened steel and its thrust is taken by roller bearings. The wormwheel is of two-piece construction. The center is of steel while the rim is of bronze. Both the worm and wormwheel are incased and run in grease.

The carriage has a full-length bearing on the shears and is provided with taper gibs to take up wear, and has hand-adjustment automatic stop and quick-power return.

The feed is by a combination of a friction disk and gear train. The mechanism provides a range of feeds from $\frac{5}{16}$ to 2½ in. per min.

Two instantly available peripheral speeds of the saw are provided for. These are 30 and 50 ft. or 40 and 60



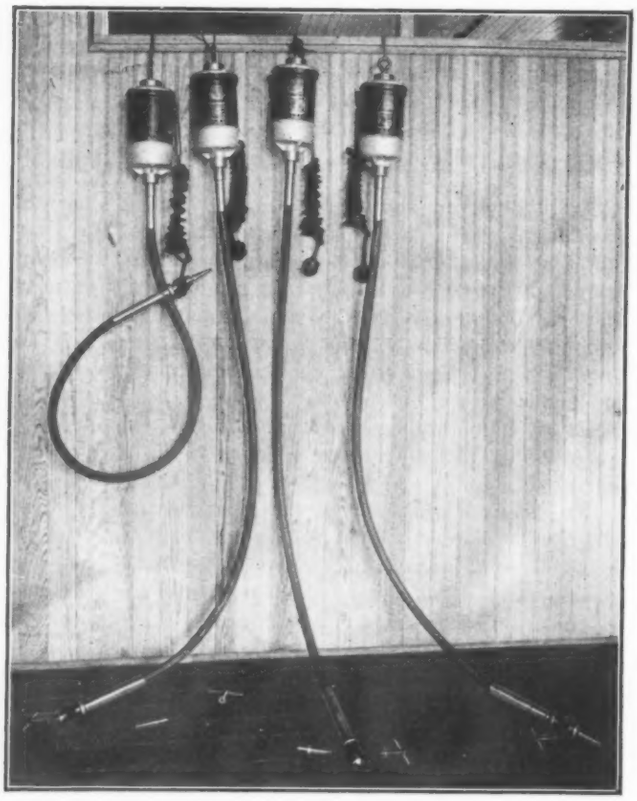
COLD-METAL SAWING MACHINE

ft. per min. respectively, according to the special requirements of the user.

The lever controls for the feed, peripheral speed and the return of the saw are placed conveniently for the operator. All gears run in oil and internal bearings are piped from the exterior of the machine. An oil trough extends around the work table. A geared pump supplies the cutting lubricant.

Flexible-Shaft Electric Portable Tools

The illustration shows some of the latest product of the Standard Electric Tool Co., Cincinnati, Ohio. The motors used are ½ hp., 220 volt, 50 cycle, 3 phase, and run at 950 r.p.m. The speed reduction is obtained through a gearbox on the lower end of the motor case,

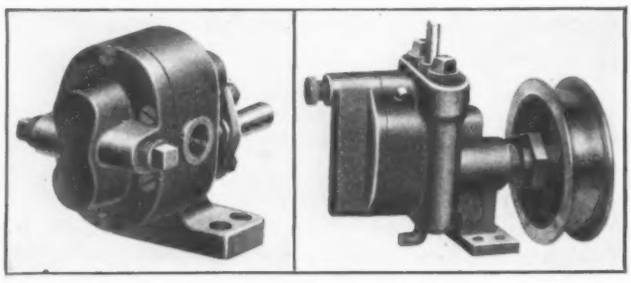


FLEXIBLE-SHAFT ELECTRIC TOOLS

carrying gears of the ratio of 4 to 1, which gives a machine great power. The flexible shafts on these particular machines are 6 ft. in length, but can be furnished any desired length. As the machines are used for both drilling and polishing, small arbors are furnished, shown in the two outside machines, which may be placed in the chucks to hold small polishing wheels. The machines weigh about 30 lb. each.

Oil-Circulating Pumps

The form of lubricant pump shown is the latest product of C. F. Roper & Co., Hopedale, Mass., and is designed to be an improved type to that shown on page 611, Vol. 44.



ONE-WAY AND REVERSING OIL-CIRCULATING PUMPS
Three sizes of each, capacities 8, 16 and 46 qt. per min. at 500 r.p.m.

This pump was designed to meet particularly the requirements of machine-tool application where the delivery of the lubricant is varied to suit the work. Separate relief valves and the piping required for them are eliminated and a plain suction and discharge pipe is all the piping required. There are no valves to adjust to vary the delivery. The cock on the delivery pipe is simply closed until the amount delivered is satisfactory. The pump automatically takes care of the surplus and keeps the delivery at a constant pressure.

The pump is made in both the styles shown—one-way and reversing.

William A. Warman

William A. Warman, in charge of the design of special machinery and research work for the Keller Mechanical Engraving Co., Brooklyn, N. Y., for the past twelve years, died at Saranac, N. Y., on July 2, 1916, after a lingering illness.

Constitutionally, Mr. Warman was of a type that belittled his own efforts and never assumed an aggressive attitude in regard to his own accomplishments; for which reason, although well known in mechanical circles, particularly the machine-building field, he had not become so conspicuous a figure as his mechanical ability and accomplishments should have made him.

Mr. Warman was born in Latrobe, Ohio, in 1861. It was thought that from his grandfather, who operated a foundry and machine shop in Latrobe, he had inherited his mechanical inclination, for early in life a natural bent toward mechanics took form. His first work as a young man was in the domain of invention and for several years he spent most of his time and effort in the development of a variety of mechanical inventions which eventually reached the world as commercially practical devices. The inventive faculty remained as one of his chief characteristics throughout his mechanical career, for in later pursuits, although associated with manufacturing propositions, he seemed to naturally turn toward those sides of his problem that possessed opportunity for original work. He had an utter disregard for precedent and was consequently an almost perpetual experimenter.

Probably Mr. Warman's strongest characteristic in the shop was mechanical resourcefulness. He had a peculiar faculty for overcoming mechanical difficulties and usually his methods were of a simple nature. Possessed of a searching mechanical mind, his realization of the difficulties involved in machine design and construction was a ready one and his practicability promptly suggested remedies that seldom failed to completely meet the case.

Before he became interested in the mechanical engraving development, he had been superintendent and designer for the Ritter Dental Manufacturing Co., Rochester, N. Y. Later on he became connected with the Dick Press Guard Manufacturing Co., which was reorganized at the time of his acquisition to manufacture press guards of Mr. Warman's design. This connection goes back some twenty years, and if Mr. Warman was not the first to conceive of a practical press guard, he was generally credited as one of the pioneers in modern press-guard construction. Although not generally known, it is believed that Mr. Warman was the inventor of the hollow setscrew, in the manufacturing methods of which he was especially resourceful.

It is not surprising to find in the ingenious type of mechanic that Mr. Warman represented, the extensive use of the slide rule in the solution of all classes of mechanical problems, and Mr. Warman was no exception in this direction. In fact, the slide rule with him was a hobby, and he designed many original forms to meet special requirements.

Through his experience as a designer of special machinery, he soon came to have a high appreciation of toolroom and other precision work. He was one of the first to realize the full possibilities of the microscope in toolroom processes and designed an especially practical mounting for toolroom application.

His mechanical engraving work antedated by a number of years his connection with the Keller Mechanical Engraving Co. For the manufacture of an engraving machine of his own design, he organized the Warman Co., which was subsequently absorbed by the Keller company in 1905.

In recent years Mr. Warman had given considerable study to gas-turbine and air-compressor work. In these fields, however, he had not fully completed his inventions and experiments.

NEW PUBLICATIONS

INVENTORS AND MONEY-MAKERS—By F. W. Taussig. One hundred and thirty-five 4½x7¼-in. pages; indexed; cloth bound. The Macmillan Co., New York City. Price, $1.

This is a readable, thought-stirring book, concerning which each one must form his own opinion. It contains the substance of lectures delivered by the author at Brown University, in connection with the celebration of the one hundred and fiftieth anniversary of the university's foundation. A part of the final paragraph sums up the author's conclusion. It is: "As regards the topics taken up in these lectures, we must be content to face and accept the complexity of human motivation, the interplay of conflicting instincts, a tantalizing uncertainty concerning the possibilities of modifying their relative strength. And yet we may cherish none the less a hope that in the future they may be made to work for human happiness more effectively than has been the case in the past."

Of the four chapters the first two deal with The Instinct of Contrivance; the third takes up The Psychology of Money-Making, and the last is entitled Altruism; the Instinct of Devotion. The author ably argues, with a wealth of supporting facts, that the propensity to contrive is a natural inherited instinct. He points out that this instinct is widespread in the animal world, the beaver and the bee being notable illustrations. He then leads us to this conclusion: "And among the inherited instincts, in men as in animals, we have to deal with that of contrivance and construction."

From this starting point it is easy to pass to a consideration of the controlling propensities in the inventor, and after questioning the need of a patent system to compel men to discover and contrive, he invites us to consider this opinion: "Men would invent anyhow; they obey the instinct and therein take joy."

Space forbids the reviewer to make more quotations in support of the compelling instinct to contrivance that the author discerns as a moving force in the lives of many great inventors from whose achievement he draws illustrations.

Some 70 pages of the book are devoted to this discussion, leading to the concluding paragraph of the second chapter—Comments on Wage Systems and Scientific Management. After expressing his belief that the familiar schemes for remodeling the wage system promise little relief from our difficulties, he speaks favorably of scientific management, saying: "On the other hand, there seem to be considerable possibilities in what is called scientific management. But the management must be not only scientific, but human."

The last two chapters discuss money-making and altruism as instincts or motives that complicate the following out of the instinct of contrivance and production. Concerning altruism, the author asks this question: "We come thus to the last named among the instinctive tendencies, that of devotion, or—since we have in mind the community as a whole—public spirit. How far is it also to be enlisted in the struggle?"

ELEMENTARY MECHANICAL DRAWING—By Charles William Weick. Two hundred and fifty 6x8-in. pages; 154 illustrations; indexed; cloth bound. McGraw-Hill Book Co., New York City. Price, $1.75.

Reviewed by A. L. Ormay*

The book is of an elementary nature, designed as a textbook for classroom use in vocational and trade schools. In entering an already overcrowded field it is assumed that the author has found, as the result of his experience in teaching the subject, certain features lacking in previous works when the main thought is for student requirements.

Although the book is calculated to cover the art of mechanical drawing from both the theoretical and practical sides, there are numerous indications that the practical considerations have suffered through a concentrated effort to keep the book within the scope of elementary students. For instance, the first two chapters, covering Instruments and Materials and The Use of Instruments, describe in minute detail, through 35 pages, the various operations in mechanical drawing, whereas Chapter V, on Drawing-Room Practice and Conventions, is rather incomplete and is poorly illustrated through overshaded surface-shaded examples.

Similarly the chapter on Projections appears incomplete. To this subject, the most important from the practical point of view, only 17 pages are devoted, and here again the examples given to elucidate the principles of the various projections suffer in clearness through overshading. In itself this chapter appears decidedly insufficient, but it is possible that the author had in mind compensation for this brevity in the following chapter on Mechanical-Drawing Practice, in which some 70 pages are devoted to examples of projections of lines, planes and solids, with a few working-drawing subjects. On the latter point a conspicuous omission is an example covering the development of intersecting surfaces—an absolutely essential consideration in working drawings.

On the whole, however, the chapter on practice is one from which the student will derive much value. It is divided into the following five sections: Instrument Exercises, Projections of Straight Lines, Projections of Plane Figures, Projections of Solids, Working Drawings. Practical considerations should suggest a change in the order of the sections, so that the first one on Instrument Exercises would become the last, following that on Working Drawings.

Other chapters of the book, dealing with the Method of Procedure in Drawing, Lettering, Geometrical Problems, Mensuration and the Reproduction of Drawings, are comprehensive. In the chapter devoted to geometrical problems the treatment is justifiably elaborated, and likewise the importance of the chapter on mensuration is emphasized on the basis that in the development of working drawings draftsmen are continually required to calculate areas, circumferences, etc.

Although the reviewer considers the deficiencies pointed out herewith of importance, a broad viewpoint suggests that the book as a whole will fill a valuable place. For the most part the fundamentals are well covered, and the multitude of examples show careful consideration in the selection.

In reverting to the chapter on Mechanical-Drawing Practice—a chapter splendidly conceived and carried out for the student purposes intended—the method of dividing the problems into two sections, one dealing with wood construction and the other with metal work, is to be commended.

STEEL AND ITS HEAT-TREATMENT—By Denison K. Bullens. Four hundred and thirty-one 5½x9-in. pages; 223 illustrations; indexed; cloth bound. John Wiley & Sons, Inc., New York City. Price, $3.75.

Reviewed by H. Diederichs†

This book is another addition to the rapidly growing literature on the heat-treatment of steel. It shows throughout the earmarks of having been written by an authority trained in both theory and practice, and will therefore, in the reviewer's opinion take a high place in this special field.

The book is divided into 18 chapters, of which the first, on the Testing of Steel, gives little more than definitions of terms. The second chapter, on the Structure of Steel, logically precedes the discussions on Annealing, Hardening, Tempering and Toughening in the three chapters following and gives in approximately 20 pages a generally satisfactory treatment on the inter-relation of the various constituents and the effects of temperature changes. Based upon this theoretical discussion, the chapters on Annealing, Hardening, Tempering and Toughening show concisely the why and wherefore of the various heat-treatments under these heads. The chapters on Hardening and Tempering also discuss briefly the methods and media used in quenching and the precautions required to prevent warping and cracking.

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*Chief Draftsman, Hill Publishing Co.

†Professor, experimental engineering, Sibley College, Cornell University.

Chapters 6 and 7 treat fully of Case Carbonizing and Case Hardening. It is quite common in practice to designate these two operations collectively as case hardening. This is probably a relic of the older days when the need for a careful and separate heat-treatment after the carbon addition to form the case was not so clearly realized. The two steps of the process are quite distinct, and the practice of using the two terms can only be commended.

Having covered the various heat-treatments and their results upon the physical properties of the steels, the author now proceeds to discuss means of generating and applying the required degree of heat. Chapter 8 deals with Heat Generation. This is only a general discussion of comparative fuel costs, etc., and strikes the reviewer as being the least satisfactory chapter in the book. The following chapter, on Heat Application, is much better, showing a great variety of furnace constructions in the shape of conventional sketches and giving the good and bad points of each.

Chapters 10 to 15 treat in turn of the physical properties of straight carbon, nickel, chrome, chrome-nickel, vanadium, chrome-vanadium, manganese, silicon and other alloy steels as affected by composition and heat-treatment. Taken together, these chapters form a valuable and complete collection of a large mass of information on these now so important topics. The chapter on nickel steels covers approximately 40 pages, that on the chrome and the chrome-nickel steels about the same space. This does not mean that the author has followed the general craze which assumes that the alloy steels are a general cure-all. On the contrary, he does not slight the straight C steels; neither does he hold up one type of alloy steel as being the thing. He is particularly careful to take no decided stand in the case of nickel-chrome vs. chrome-vanadium steels and points out the limitations of the various alloy steels. The stand taken can only be commended.

The reviewer feels that the alloy-steel business has been overdone and that in many cases a good straight C steel of proper composition and with proper heat-treatment would fill the bill as well if not better. It is of course true that some failures of alloy steel in practice cannot be laid to wrong composition. But it is a fact that the proper handling of such steels in casting, forging and heat-treatment is a more delicate operation than with straight C steels. When it is considered that the conditions in many forge shops are anything but scientific (see pages 405 to 407 of the book under review), both in regard to temperature control and manner of forging, it is perhaps not surprising that failures should occur. The conclusion to be drawn from this, however, should be to go a little slow in the general specification of high-priced alloy steels for every conceivable purpose.

Chapter 16 treats specifically of tool steels and their heat-treatment. It gives a complete table of tempers for various purposes, discusses the relation between temper colors and hardness and ends up by giving specific directions for treating chisels, dies, drills, milling cutters, reamers, etc., etc.

Chapter 17, on Miscellaneous Treatment, is virtually a continuation of Chapter 16, discussing the proper treatment for gears, springs, oil-well bits, safe and vault steel, steel castings and steel wire. The chapter closes with a few remarks on present forging practice which are to the point.

The book ends with a chapter on Pyrometers and Critical Range Determinations. The extreme importance of the pyrometer is set forth, and the various types are described. Then follows a discussion on calibration and standardization of pyrometer equipment and the methods of finding the decalescent and recalescent points.

The figures throughout the book are generally good, and this is particularly true of the microphotographs. The entire book, with the possible exception of the chapter on Heat Generation, gives the impression of being a careful work. There may be several statements, particularly in connection with the theory of steel structure, to which exception might be made. But these things are of minor importance in view of the general excellence and are no doubt due to the fact that there are several schools of metallographists not in entire accord on the theory as a whole.

Increasing Base Diameters of Shells--Correction

In the article published on page 36, under the above title, it was erroneously mentioned that a pneumatic hammer was mounted in a special carriage of the lathe, whereas it was an electric hammer.

In the instance covered the electric hammer shown was the product of the Electro-Magnetic Tool Co., Chicago, Ill., to whom we are indebted for calling attention to the error.

BUSINESS ITEMS

Wagner Electric Manufacturing Co., St. Louis, Mo., announces the removal of its Detroit office to 1291 Woodward Ave., to continue in charge of Dean Emerson.

Crescent Co., 125 State St., Meriden, Conn., has equipped a plant at the above address and is making and marketing a line of hacksaw blades and frames. L. E. Jennings is general manager.

H. P. Mueller, brass founder, St. Louis, Mo., has enlarged his foundry to make provision for the manufacture of McAdamite metal castings for submarine-boat covers, pump pistons and aëroplane parts.

PERSONALS

L. W. Adams, for some time superintendent of the rolling mills of the Lehigh plant of the Bethlehem Steel Co., has been made superintendent of the Soucon plant, succeeding R. F. Randolph, resigned.

J. A. Eden, Jr., for several years associated with the Baush Machine Tool Co., Springfield, Mass., has resigned. Mr. Eden was previously associated with United Engineering and Foundry and the E. W. Bliss companies.

James H. Zeller, until recently production engineer with the American Bronze Co., Berwyn, Penn., has become associated with the Penn Barrel Co., Philadelphia, Penn., where he will act as assistant superintendent.

E. A. Moore, formerly superintendent of the Fairbanks-Morse Mfg. Co., Beloit, Wis., and previously with the Bullard Machine Tool Co., has become works manager of the Union Switch and Signal Co., Swissvale, Penn.

Henry M. Sonnenthal and **Frederick M. Sonnenthal,** directors of the Selson Engineering Co., Ltd., London, England, with an American branch at 78 Broad St., New York City, in charge of Henry M. Sonnenthal, have changed their surnames to Selson.

H. E. Streeter, until recently works manager of the Precision Tool and Machine Co., Montreal, Canada, and previously Canadian representative of the Heald Machine Co., has joined the sales organization of the Gronkvist Drill Chuck Co., Jersey City, soon to be known as the Swedish Gage Co.

FORTHCOMING MEETINGS

American Foundrymen's Association and American Institute of Metals. Annual meeting, September 11-16, Cleveland, Ohio. A. O. Backert, secretary, American Foundrymen's Association, Cleveland, Ohio.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	July 14, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$14.00	$14.50	$9.75
No. 2X Northern Foundry, New York	19.75	19.75	14.25
No. 2 Northern Foundry, Chicago	19.00	19.00	13 00
Bessemer, Pittsburgh	21.95	21.95	14.95
Basic, Pittsburgh	18.95	18.95	13 90
No. 2X, Philadelphia	19.75	20.00	14.25
No. 2, Valley	18.25	18.00	12.75
No. 2 Southern, Cincinnati	16.90	17.40	12.65
Basic, Eastern Pennsylvania	19.00	19.75	14.00
Gray forge, Pittsburgh	18.70	18.70	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger, tees 3 in. and larger and plates ¼ in. and heavier, from jobbers' warehouse at the places named:

	New York				
	July 14, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.25	3.50	1.85	3.25	3.10
Steel T's, base	3.30	3 55	1.90	3.25	3.10
Machinery steel (bessemer)	3.25	3.50	1.80	3.25	3.10
Plates	4.00	4.00	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	July 14, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.65	2.60	3.20	3.20
No 26 black	3.55	3.55	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.50	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.45	2.40	3.00	3.00
No. 16 blue annealed	4.45	4.45	2.35	3.70	3 60
No. 14 blue annealed	4.35	4.35	2.25	3.60	3.50
No. 12 blue annealed	4.30	4.30	2.20	3.55	3.45
No 10 blue annealed	4.25	4.25	...	3.50	3.40
No. 28 galvanized	5.40	5.65	6.00	5.20	5.10
No. 26 galvanized	5.10	5.35	5.70	4.90	4.80
No. 24 galvanized	4.95	5.20	5.50	4.75	4.65

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black		Galvanized	
	July 14, 1916	One Year Ago	July 14, 1916	One Year Ago
¾ to 2 in. steel butt welded	70%	79%	50½%	57½%
2½ to 6 in. steel lap welded	68%	78%	48½%	56½%
Diameter, In.				
¾	3.45	2.42	5.69	4 89
1	5.10	3.57	8.42	7.23
1¼	6.90	4.83	11.39	9.78
1½	8.25	5.78	13.61	11.69
2	11 10	7.77	18.32	15.73
2½	18.72	12.87	30.13	25.45
3	24.48	16.83	39.40	33.28
4	34.88	23.98	56.14	47.42
5	47.36	32.56	76 22	64.38
6	61.44	42.24	98.88	83.52

From New York stock the following discounts hold:

	New York		Cleveland	
	Black	Galvanized	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%	64%	44%
¾ to 3 in. steel butt welded	64%	42%	66%	46%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	July 14, 1916	Three Months Ago
Pittsburgh, mill	2.50	2.50
Warehouse, New York	3.25	3.15
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York					
Today	One Year Ago				
$6.00	$3.75@4.00	Cleveland	$6.30	Chicago	$5.25

In coils an advance of 50c. is usually charged.

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	July 14, 1916	Three Months Ago
New York	20% above list	15% above list
Cleveland	20% above list	20% above list
Chicago	10% above list	List price

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets ..... $2.25 Bars $3.00

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	July 14, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	27.00	28.50	20.00
Tin	38.75	42.00	37.50
Lead	6.50	7.00	5.75
Spelter	9.00	13.12½	22.00
ST. LOUIS			
Lead	6.37½	6.85	....
Spelter	8.50	13.00	....

At the places named, the following prices in cents per pound prevail:

	New York				
	July 14, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	37.50	25.00	37.50	37.50
Copper wire (carload lots)	37.50	37.50	28.25	33.00	38.00
Brass rods, base	44.50	44.50	25.50	38.00	40.00
Brass pipe, base	46.50	46.50	29 00	45.00	45.00
Brass sheets	44.50	44.50	26.25	42.00	38.00
Solder ½ and ⅓ (case lots)	24.12½	27.37½	27.50	27.00	25.50

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland	
	July 14, 1916	One Year Ago	July 14, 1916	Three Months Ago
Copper, heavy and crucible	20.50	16.50	19.00	22.00
Copper, heavy and wire	19.50	16.25	18.50	21.00
Copper, light and bottoms	16.00	14.00	16.00	19.00
Lead, heavy	5.00	4.00	5.25	6.75
Lead, tea	4.50	3.75	4.00	5.50
Brass, heavy	11.25	11.00	12.00	18.00
Brass, light	9.25	10.00	9.00	12.00
No. 1 yellow rod brass turnings	12.75	11.00	12 00	16.25
Zinc	7.00	13.00	6.00	14.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
$\frac{3}{16}$ to $\frac{7}{32}$	35.50	36.00	36.50	37.00	38.00
¼ to $\frac{15}{32}$	35.25	35.75	36.25	36.75	37.75
$\frac{3}{8}$ to $1\frac{7}{8}$	35.00	35 50	36.00	36.50	37.50
$1\frac{15}{16}$ to $2\frac{7}{8}$	35.75	36.25	36.75	37.25	38.25
Rounds					
3 to $3\frac{7}{16}$	36.50	37.00	37.50	38.00	39.00
Squares					
3	36.50	37.00	37.50	38.00	39.00
Rounds					
$3\frac{1}{2}$ to $3\frac{15}{16}$	36.25	36 75	37.25	37.75	38.75
Squares					
$3\frac{1}{16}$ to $3\frac{15}{16}$	36.25	36.75	37.25	37.75	38.75
Rounds—Squares					
4 to $4\frac{15}{16}$	37.00	37.50	38.00	38.50	39.50
5 to $6\frac{15}{16}$	38.00	38.50	39.00	39.50	40.50
7	38.50	39 00	39.50	40.00	41.00
Flats	36.50	37.00	37.50	38.00	39.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.
Hexagon bars 2c. per lb. over corresponding size of round rods.
For cutting to any specified length not shorter than 1 ft. add 1c. per lb.
The scrap allowance is 18c. per lb. delivered at works.

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	55.00	46.50	55.00
Commercial	25.00	17.50	21.00

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 15.00

	In Casks		Broken Lots	
	July 14, 1916	Three Months Ago	July 14, 1916	Three Months Ago
New York	18.00	26 00	19.00	26.50
Cleveland	22.50	26.00	23.00	26.50
Chicago	20.50	26.50	21.00	27.00...

Copper Bars from warehouse sell as follows in cents per pound:

	July 14, 1916	Three Months Ago
New York	41.00	41.00
Cleveland	40.25	31.50
Chicago	40.50	37.25

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	July 14, 1916	Three Months Ago
New York	14.00	43.00
Cleveland	19.00	50.00
Chicago	20.25	45.00

Copper Sheets—In New York, from warehouse, hot rolled 16 oz. (large lots) base per lb. is 37.50c.; cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

SHOP SUPPLIES

Nuts—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	July 14, 1916	Three Months Ago	July 14, 1916	Three Months Ago	July 14, 1916	Three Months Ago
Hot pressed square	$2.00	$2.75	$2.75	$3.50	$3.25	$3.70
Hot pressed hexagon	2.00	2.75	2.75	3.75	3.25	3.80
Cold punched square	1.50	2.50	2.50	3.00	3.00	3.25
Cold punched hexagon	2.00	3.00	3.00	3.75	3.50	4.00

Semifinished nuts sell at the following discounts from list price:

	July 14, 1916	Three Months Ago
New York	50—10%	65%
Cleveland	60%	70—10%
Chicago	65%	70%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅜ by 6 in.	45—5%	50—10—5%	60—5%
Larger and longer	35%	40—15%	50%

At this rate the net prices are as follows:

Length, In.	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.53	....	....	$0.43	....	....	$0.38	....	....
2	.58	....	....	.48	....	....	.42	....	....
2½	.63	$2.12	$5.53	.51	$1.39	$3.63	.46	$1.63	$4.25
3	.68	2.30	5.85	.55	1.51	3.85	.50	1.77	4.50
3½	.73	2.48	6.18	.60	1.64	4.06	.54	1.91	4.75

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅜ by 6 in. and smaller	50%	60 and 5%	60 and 10%
Larger and longer up to 1 in. by 30 in.	40%	50 and 5%	50 and 10%

At this rate the net prices per 100 follow:

Length, In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2	$0.83	$2.32	$9.60	$0.68	$1.54	$6.08	$0.64	$1.74	$7.20
2½	.89	2.84	10.14	.71	1.57	6.42	.67	1.85	7.60
3	.97	2.63	10.68	.74	1.67	6.76	.70	1.97	8.00
3½	1.01	2.97	11.22	.78	1.86	7.48	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York..... $4.00 Cleveland..... $5.75 Chicago..... $6.00

At this rate the net price per 100 lb follows:

Size of Bolt	New York	Cleveland	Chicago
7/16	$10.00	$8.25	$8.00
¼	8.20	6.45	6.20
5/16	7.40	5.65	5.40
⅜	6.50	4.75	4.50
7/16	5.80	4.05	3.80
½	5.40	3.65	3.40
9/16	5.30	3.55	3.30
⅝	5.10	3.35	3.10
¾	5.00	3.25	3.00
⅞, 1, 1⅛	5.20	3.45	3.20
1¼, 1⅜, 1½	5.20	3.45	3.20
1⅝, 1¾, 1⅞, 2	5.50	3.75	3.50
2¼, 2½	6.50	4.75	4.50

For cast-iron washers the base price per 100 lb. is as follows:

New York..... $2.50 Cleveland..... $2.00 Chicago..... $6.00

Rivets—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	45%	45—10%	50%
Tinned	45%	45—10%	50%

Button heads, ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb:

New York..... $5.25 Cleveland..... $4.05 Chicago..... $3.50

Coneheads, same sizes:

New York..... $5.35 Cleveland..... $4.15 Chicago..... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1⅛ to 1⅞ in. long, all diameters	$0 25	1 in. long and shorter	$0.50
⅝ in. diameter	.15	Longer than 5 in.	.25
½ in. diameter	.50	Less than kegs	.50
		Countersunk heads	.50

Nails—Wire nails f.o.b. Pittsburgh sell at $2.50@2.60; galvanized 1 in. and longer, $4.50@4 60, and shorter, $5@5.10. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse, wire and cut nails sell as follows:

	Wire		Cut	
	July 14, 1916	Three Months Ago	July 14, 1916	Three Months Ago
New York	$3.15	$2.90	$3.15	$2.90
Cleveland	3.05	2.95	2.95	2.85
Chicago	2.85	2.70	2.85	2.70

Copper Rivets and Burs sell at the following rate from warehouse:

	Rivets		Burs	
	July 14, 1916	Three Months Ago	July 14, 1916	Three Months Ago
Cleveland	List price	List price	List price	List price
Chicago	List price	List price	List price	List price
New York	10-2½% from list	20% from list	10-2½% from list	10% above list

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire		Cast-Iron Welding Rods	
3/32, 1/16, 5/64, ¼, 7/32, 5/16	10.00	¼ by 19 in. long	22.00
No. 8, 9/32 and No. 10	11.00	5/16 by 12 in. long	26.00
⅛	12.50	3/16 by 19 in. long	20.00
No. 12	13.50	½ by 21 in. long	20.00
5/32, No. 14 and 1/16	15.00		
No. 18	16.50	Vanadium Wire in Coils or Sticks	
No. 20	17.50	1/16	15.50
Special Welding Wire		3/32	15 00
⅛	33.00	⅛	14.00
5/32	30.00	5/32	12.00
3/16	38.00	3/16 and larger	11.00

Seamless Drawn Tubing—The base price per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	43.50	46.00	42.00
Copper	48.00	48.00	43.00

For immediate stock shipment the following quotations hold:

Diameter, In.	Copper: New York July 14, 1916	Copper: New York One Year Ago	Copper: Cleveland	Copper: Chicago	Brass: New York July 14, 1916	Brass: New York One Year Ago	Brass: Cleveland	Brass: Chicago
¾ to 2½	51 50	35.50	48.00	43.00	46.60	32.50	46.00	42.00
3	51.50	35.50	48.00	43.00	46.60	32.50	46.00	42.00
3½	52.50	36.50	48.00	44.00	47.50	33.50	46.60	43.00
4	53.50	37.50	51.00	45.00	50.50	34.50	49.00	44.00
4½	55.50	39.50	51.00	47.00	50.50	36.50	49.00	46.00
5	57 50	41.50	53.00	49.00	52.50	38.50	51.00	48.00
6	58.50	42.50	55.00	50.00	53.50	39.50	53.00	49.00
7	60.00	44.50	55.00	52.00	55.50	41.50	53 00	51.00
8	62.50	46.50	59.00	54.00	57.50	43.60	57.00	53.00

Tin Plates—The following prices are in effect from warehouses at the places named:

	New York July 14, 1916	New York Three Months Ago	Cleveland July 14, 1916	Cleveland Three Months Ago	Chicago July 14, 1916	Chicago Three Months Ago
Coke tin plate, 14x20:						
100 lb.	$6.50	$5.00	$6.00	$5.00	$6.00	$5.00
I. C. 107 lb.	6.65	5.15	6.15	5.15	6 15	5.15
Terne plate, 20x28:						
Base Weight / Net Weight / Coating						
100 lb. 200 8...	$10.50	$9.50	$9 35	$9.10	$8.90	$8.50
I. C. 214 8...	10.80	8.90	9.60	9.35	9.25	9.10
I. X. 270 8...	12.80	11.80	11.85	11.60	11.50	11.15
I. C. 218 12...	12.50	12.00	10.75	10.25	10.75	11.25
I. C. 221 15...	13.50	13 00	10.75	10.50	11.60	11.50
I. C. 226 20...	14.50	13.50	12.75	12.50	12.50	12.20
I. C. 231 25...	14.75	14.25	13.75	13.50	13 75	13.50
I. C. 236 30...	16.50	15.50	14.75	14.50	14.75	14.50
I. C. 241 35...	18.00	17 00	16.00	15.75	15.85	16.00
I. C. 246 40...	20.00	19.00	17.00	16.75	17.10	16.75

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	June 24	July 1	July 8	July 15
Prompt furnace	$2 40@2.50	$2.40@2.50	$2.40@2.50	$2.40@2.50
Prompt foundry	3.25@3.50	3.25@3.50	3.25@3.50	3.25@3.50

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	10.00@12.00	11.00@14.00	10.50@13.00
Colored mixed	7.00@ 9.00	7.50@11.00	7.50@10.00

Sal Soda sells as follows per 100 lb.:

New York..... $2.05 Cleveland..... $2.25
Philadelphia..... 1.80 Chicago..... 1.90

Roll sulphur in 360-lb. bbl. sells as follows per 100 lb:

New York..... $2.75 Cleveland..... $2.75 Chicago..... $2.75

Wiping Cloths—In Cleveland the jobbers' price per 1,000 is as follows:

13¼x13¼ ..... $29.50 13¼x20½ $35.00

Fire Clay—In Cleveland it is $3.25 per ton for carload lots. In Chicago it is 50c. per bag of 100 lb.

Linseed Oil—These prices are per gallon:

	New York July 14, 1916	New York Three Months Ago	Cleveland July 14, 1916	Cleveland Three Months Ago	Chicago July 14, 1916	Chicago Three Months Ago
Raw in barrels	$0.71	$0.81	$0.73	$0.80	$0.67	$0.83
5-gal. cans	.81	.91	.83	.90	.77	.91

White and Red Lead, in cents per pound, sell as follows:

	Red: Dry	Red: In Oil	White: Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12½-lb. keg	11 00	11.50	11.00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

Metal Working

NEW ENGLAND STATES

Maine, Ft. Kent—Hetherington & Mallett is having plans prepared for a public garage. Estimated cost, $15,000.

Vt., Rutland—Patch Manufacturing Co., manufacturer of shrapnel, is rebuilding its plant. Noted June 22.

Mass., Boston—(Charlestown)—Freeman Bros., Sullivan Sq., has awarded the contract for a 2-story, 40x54-ft. garage.

Mass., Boston—(South Boston)—The contract has been awarded for a 3-story plant at South Boston for the United States Fastener Co., 93 Milk St.

Mass., Cambridge—Bids are being received by H. A. Mears, Arch., 6 Beacon St., Boston, for a 2-story factory for Ernest Flentjie, 1645 Cambridge St., manufacturer of auto supplies.

Mass., Chicopee—A 1-story addition will be built to the plant of the Excelsior Needle Co.

Mass., Worcester—Packard Motor Car Co. is having plans prepared by O. C. S. Ziroli, Arch., 306 Main St., for a 1- and 2-story garage and salesroom. Address A. T. Fuller, 1089 Commonwealth Ave., Allston.

R. I., Providence—Thomas Quinn will build a 1-story, 60x70-ft. garage with 30x56-ft. wing on Ornes St.

R. I., Providence—Peckham Bros Co. will build a 1-story, 100x140-ft. garage and service station at Warren St. and Elmwood Ave.

Conn., Hartford—A 3-story garage and service building will be constructed at Asylum and Hurlbut St. by the Overland Stores Co., Toledo, Ohio. Estimated cost, $140,000.

Conn., New Haven—F. B. Shuster Co., 133 Mill River St., has awarded the contract for a 1-story factory for the manufacture of hardware and machinery.

Conn., South Norwalk—James A. Farrell, Belle Island, has awarded the contract for a 2-story garage. Estimated cost, $30,000.

Conn., West Hartford—The contract has been awarded for a 1-story addition to the plant of the Abbott Ball Co.

MIDDLE ATLANTIC STATES

N. Y., Buffalo—A large forge plant is being constructed by the Sizer Forge Co.

N. Y., Lockport—A plant will establish at Lockport by the Elderfield-Hartshorn Hardware Co., Niagara Falls.

N. Y., New York—(Borough of Brooklyn)—An addition will be built to the plant of the Adriance Machine Co.

N. Y., New York—(Borough of Brooklyn)—A 1-story addition will be built to the finishing shop of the O. J. Bloss Iron Works, 253 Monitor St.

N. Y., New York—(Borough of Brooklyn)—Plans are being prepared by W. J. Conway, Arch., 400 Union St., for the construction of an addition to the factory of the U. S. Electro Galvanizing Co., 1 Park Ave. Estimated cost, $8,500. M. I. Doyle, Asst. Mgr.

N. Y., New York—(Borough of Manhattan)—Plans are being prepared by De Roas & Savignano, Arch., 150 Nassau St., for a 4-story garage at 52 Watt St. for M. Zurille.

N. Y., New York—(Borough of Manhattan)—F. Sandford plans to construct a 4-story, 50x100-ft. garage at 140 West 54th St. Estimated cost, $50,000. A. W. B. Wood, 103 Park Ave., Assoc. Arch.

N. Y., New York—(Borough of Manhattan)—Plans have been prepared by Scmmerfeld & Steckler, Arch., 31 Union Sq., for a 2-story garage at 421 West 115th St., for E. Haggin, 1 Madison Ave.

N. Y., New York—(Borough of Queens)—Ford Motor Co. has awarded the contract for the construction of a factory.

N. Y. Niagara Falls—A 2-story machine shop will be constructed by the Titanium Alloy Manufacturing Co.

N. Y., Port Jefferson—Wetzel Mechanical Stoker Co., Port Jefferson, recently incorporated with $15,000 capital stock, will establish a plant to manufacture stokers and general hardware. The plant will include a foundry. C. A. Yawger is interested.

N. Y., Rochester—The contract has been awarded for a 2-story garage for W. A. Naramore, 110 Westminster Rd. Estimated cost, $20,000.

N. Y., Schenectady—General Electric Co. is in the market for boring mills and turret and engine lathes. Noted June 15.

N. Y., Syracuse—Genesee Motor Car Co. has awarded the contract for a 3-story garage and showrooms. Estimated cost, $50,000. Noted Feb. 24.

N. Y., Syracuse—The contract has been awarded for the construction of a 2-story, 80x300-ft. factory for the Sanderson Works of the Crucible Steel Co. of America. Estimated cost, $75,000.

N. Y., Throopsville—Fire recently damaged the plant of Weddingen & Meyer, manufacturer of farm implements.

N. J., Avenel—Steel Furniture Co. is building a 3-story, 82x622-ft. plant.

N. J., Bartley—A 2-story foundry and machine shop will be constructed by William Bartley & Sons to replace the building recently destroyed by fire.

N. J., Bloomfield—Sprague Electric Works of General Electric Co., manufacturer of motors and generators, will build a 6-story, 75x800-ft. addition to its plant. Estimated cost, $800,000.

N. J., Hoboken—Bijur Motor Lighting Co. is in the market for 12 turret lathes.

N. J., Hoboken—Fire, June 30, destroyed portion of the plant of Wilson Bros. Iron Works. Loss, $10,000.

N. J., Irvington—Irvington Smelting & Refining Works has awarded the contract for a 1-story factoryp. Estimated cost, $13,000.

N. J., Irvington—J. T. Castle's Ice Cream Co. will construct a new garage.

N. J., Newark—Edmund and Walter Goerke have awarded the contract for the construction of a garage on Elizabeth St. Estimated cost, $17,000.

N. J., Newark—A 1-story factory will be constructed on Verona Ave. by the Newark Wire Cloth Co.

N. J., Newark—Public Service Railway Co. will construct a 9-story addition to its Plank Rd. car shops. Estimated cost, $45,000.

N. J., Newark—United Talking Machine Co. will construct a plant on Emmet St.

N. J., Newark—Hanson & Van Winkle Co., manufacturer of platers supplies, has awarded the contract for the construction of a 3-story addition to its plant at Malvern and Van Buren St.

N. J., Newark—A rolling mill will be constructed by the National Lock Washer Co., 65 Johnson St.

N. J., New Brunswick—E. Mount, Englishtown, has awarded the contract for a 3-story, 40x150-ft. garage at Albany St. and Spring Alley. Estimated cost, $28,000. Noted June 8.

N. J., Trenton—Fire recently damaged the plant of John Thropp's Sons Co., founder and machinist. Loss, $20,000.

N. J., Trenton—Pyro Electrical Instrument Co., recently organized, plans to establish a plant for the manufacture of electrical measuring instruments. H. F. Porter, Trenton interested.

N. J., Trenton—H. J. Stout & Son will build a garage and machine shop on Chancery St.

Penn., Altoona—Pennsylvania R.R. is in the market for turret lathes for its Altoona shops. A. S. Shand, Philadelphia, Ch. Engr.

Penn., Ardmore—Autocar Co. has increased its capital stock to $1,800,000 and will construct nee additions to its plant and install new machinery.

Penn., Chattanooga—The contract has been awarded for the construction of a knitting mill for the Signal Knitting Co. Noted June 22.

Penn., Chester—Press reports state that the Westinghouse Electric and Manufacturing Co. plans to build a plant in Tinicum Township.

Penn., Coatesville—Lukens Iron and Steel Co. is building a plate mill, also plans addition to plant on 1st St. Noted Mar. 16.

Penn., Erie—Ball Engine Co. has awarded the contract for a 2-story addition to its plant. Estimated cost, $20,000.

Penn., Erie—An addition will be built to the plant of the Lakeside Forge Co. to be used as a machine shop. Estimated cost, $10,000.

Penn., New Castle—A factory will be constructed by the Pressed Steel Products Co. for the manufacture of steel drums.

Penn., PUhiladelphia—R. L. Chalfont will construct a garage on 46th St.

Penn., Philadelphia—An addition will be built to the plant of the Tabor Manufacturing Co., 18th St., manufacturer of machinery.

Penn., Pittsburgh—Jones & Laughlin Steel Co. is building a 1-story plant. Estimated cost, $40,000.

SOUTHERN STATES

Va., Richmond—W. S. Borbes will improve his machine shop.

W. Va., Follansbee—Follansbee Bros Co. plan to construct a new steel mill. Estimated cost, $1,250,000.

W. Va., Warwood—Globe Automatic Sprinkler Co., 2019 Washington Ave., Philadelphia, Penn., plans to build a plant at Warwood. Estimated cost, $35,000.

MIDDLE WEST

Ohio, Akron—R. K. Crawford, Pres. and Gen. Mgr. of the Ohio Land Co., will construct a public garage at 404 Wooster Ave. Estimated cost, $10,000.

Ohio, Canton—Canton Foundry and Machine Co., 3rd St. and Savannah Ave. will construct several additions to its plant.

Ohio, Cincinnati—Bids will soon be received for a garage for John Ryan. Estimated cost, $10,000.

Ohio, Cleveland—Bids are being received for a new factory at Urbana Rd. and Nickel Plate R.R. for the McLaren Iron Works Co., 1276 East 55th St., manufacturer of boilers, etc. Noted June 22.

Ohio, Dayton—Plans being prepared for an addition to the plant of the Davis Sewing Machine Co. Noted Dec. 16.

Ohio, Dayton—The Dietz Manufacturing Co. is having plans prepared for a new plant for the manufacture of patent washing machines.

Ohio, Fostoria—Fire recently destroyed the plant of the Kresler Car. Co. Loss, $55,000.

Ohio, Springfield—The Shanklin Manufacturing Co. will construct a plant for the manufacture of screw machine products.

Ohio, Toledo—Kent-Owens Co., Libbey St., manufacturer of boilers, is building an addition to its plant to cost $20,000.

Ind., Anderson—The Renny Electric Co. will construct a 3-story factory for the manufacture of machinery. Noted Mar. 23.

Ind., Evansville—Bids have been received for a public garage for the Orr Investment Co. 318 South 2nd St. Estimated cost, $35,000.

Ind., Ft. Wayne—The Ft. Wayne Engineering and Construction Co. has awarded the contract for a new plant for the manufacture of machinery, etc.

Ind., Indianapolis—The Indiana Die Casting Co. will build an addition to its plant. Die casting machinery will be purchased.

Ind., Logansport—Rutenbar Truck Motor Co. has been organized by G. W. Bowen with a capital of $450,000. The new company will take over the plant of the Western Motor Co. and will spend about $50,000 for new equipment.

Mich., Holland—Home Furnace Co. has awarded the contract for the construction of a new factory. Estimated cost, $17,000. Noted June 15.

Mich., Jackson—Michigan Central Railway Co. plans to improve its shops at Jackson Junction. Estimated cost, $250,000. G. H. Webb, Detroit, Ch. Engr.

Mich., Pontiac—The American Forging and Socket Co. is constructing an addition to its plant.

Mich., River Rough—Henry Ford, manufacturer of automobiles, will construct a plant at River Rough. Estimated cost, $8,000,000.

Ill., Chicago—Garfieldian Motor Station will soon receive bids for a 2-story garage. Estimated cost, $12,000.

Ill., Chicago—The Regal Model and Tool Works, 122 South Clark St., is constructing a plant for the manufacture of special machinery, dies, tools and automobile parts.

Ill., Glave—The Hayes Pump and Planter Co., manufacturer of farm tools and pumps, will construct an addition to its plant.

Ill., Moline—A 2-story foundry and machine shop will beconstructed at Moline by the H. J. Frank Co., Davenport, Iowa.

Ill., Monmouth—Monmouth Plow Factory is in the market for a 200-lb. helve hammer.

Ill., Rock Island—Moline Plow Co. has awarded the contract for a large plant in east end of city. Noted July 6.

Wis., Burlington—Bids will soon be received by H. Anger, Burlington, for the construction of a 1-story garage. Leiser & Holst, Germania Bldg., Milwaukee, Arch. Estimated cost, $15,000.

Wis., Chippewa Falls—A new building will be constructed by the Chippewa Foundry and Machine Co.

Wis., Chippewa Falls—Western Pump and Machine Co. is building new factory. Estimated cost, $100,000.

Wis., De Pere—J. Steckart Sons Co. will construct a new garage. Machine shop equipment will be required.

Wis., Elkhart Lake—G. A. Cramer Co. has awarded the contract for an addition to its garage to be used for a machine shop.

Wis., Eau Claire—Chippewa Foundry and Machine Co. will construct new factory.

Wis., Milwaukee—Bids are being received by C. J. Keller, Arch., Milwaukee, for the construction of a factory on Oregon St. for the General Welding and Manufacturing Co. Noted June 29.

Wis., Milwaukee—Everburn Heater Co., recently organized with $20,000 capital stock to manufacture freight car heaters, will establish a plant. C. H. Krebs, 751 Downer Ave., is interested.

Wis., Racine—Bids will soon be received for an addition to the Gorton Machine Co., manufacturer of machine tools. Estimated cost, $30,000.

Wis., West Allis—The Robert Rom Manufacturing Co., 1023 St. Paul Ave., Milwaukee, will construct a new factory on 63 Ave. and Burnham St., West Allis, for the manufacture of plumbing supplies.

Wis., West Allis—North End Foundry Co., 60th Ave. and Mitchell St. has awarded the contract for an addition to its plant.

WEST OF THE MISSISSIPPI

Iowa, Cedar Rapids—G. H. Doty will receive bids about July 27 for the construction of a 2-story garage. C. B. Zalesky, Security Bank Bldg., is Arch. Estimated cost, $20,000. Noted Mar. 30.

Iowa, Dallas Center—Brenton Bros. has had plans prepared for the construction of a 2-story, 44x80-ft. garage. Proudfoot, Bind & Rawson, Hubbell Bldg., Des Moines, is Arch.

Iowa, Marion—G. E. Groll is receiving bids for the construction of a 1-story, 60x120-ft. garage. I. F. McMinds, Security Bldg., Cedar Rapids, is Arch.

Minn., St. Paul—Martin Auto Livery is having plans prepared for the construction of a 2-story addition to its garage. J. H. Wheeler, New York Life Bldg., is Arch.

Minn., St. Paul—Specialty Manufacturing Co., Manufacturer of lawn mower attachments, is having plans prepared for a plant. Estimated cost, $20,000. C. L. Kinport, 417 Essex Bldg., is Arch.

Kan., Augusta—Woods Machinery Co. of Illinois will construct a plant at Augusta.

Kan., Pittsburg—F. H. Fitch, 1012 Baltimore St., Kansas City, Mo., has awarded the contract for the construction of a 1-story garage at Pittsburg. Noted May 11.

Mont., Pandalia—A machine shop and foundry is being constructed by the Vandalia Machine and Welding Works. D. McKay, Glasgow, in charge.

Mo., Kansas City—Ford Motor Co. has had plans prepared for the construction of a service station to cost, $200,000. A. Kahn & E. Wilby, 58 West Lafayette Blvd., is Arch.

Mo., St. Louis—J. Engel, 4737 Washington Blvd., and associates, is organizing a company with $50,000 capital stock, to establish a plant for the manufacture of plant for a patented attachment for printing presses.

Mo., St. Louis—St. Louis Electrical Works has awarded the contract for the construction of a factory on Easton Ave. Estimated cost, $12,000. Noted July 6.

Mo., Webster Groves—H. C. Wallace is receiving bids for the construction of a garage. Estimated cost, $10,000. H. C. Ames is Arch.

Tex., Ennis—A. H. Funkerley is constructing a building which will be occupied by the National Garage for a garage and machine shop.

Tex., Houston—A garage and repair shop will be constructed by the Main St. Garage. G. F. Howard is Mgr.

Colo., Denver—S. Schornburg has had plans prepared for the construction of a garage to cost $15,000. R. A. Pierce, Century Bldg., is Arch.

WESTERN STATES

Utah, Salt Lake City—The Utah Copper Co. will make large additions to the Magna and Arthur mills.

Wash., Granger—Cast & Lucas plan to construct a garage and machine shop at Granger.

Wash., Raymond—Raymond Foundry and Machine Co. will rebuild its plant which was recently destroyed by fire. Loss, $18,000.

Wash., Seattle—Washington Iron Works plans to improve and enlarge its plant, also install new equipment. Estimated cost, $100,000.

Wash., Seattle—Willys Overland Co. plans to construct a plant.

CANADA

N. B., St. John—T. McAvity Sons, manufacturer of munitions and general machinery, is constructing a new plant.

Ont., Chatham—The Dominion Sugar Co. Wallaceburg, Ont., will construct a machine shop at Chatham for making repairs to factory equipment.

Ont., St. Thomas—The Wabash Railway Co. will build a repair shop. T. J. Rirer, St. Louis, Mo., Pur. Agt. Noted Jan. 6.

Ont., Toronto—The Thor Iron Works is in the market for an electric traveling gantry crane.

Alta., Medicine Hat—The Alberta Foundry and Machine Co. will build an addition to its plant. Estimated cost, $20,000.

B. C., Victoria—Cameron & Genoa Co., shipbuilders, is making extensive improvements to its plant.

General Manufacturing

NEW ENGLAND STATES

Maine, Old Town—Penobscot Chemical Fibre Co., Great Works, has awarded the contract for a 1-story evaporator room.

Mass., Cambridge—Boston Woven Hose and Rubber Co. has awarded the contract for a 4-story addition to its plant.

Mass., Gardiner—Haywood Bros. & Wakefield Co., manufacturer of furniture, will build a 2-story addition to its plant. Estimated cost, $60,000.

Mass., Lowell—Tremont & Suffolk Mills, manufacturer of cotton goods, is building a new mill.

Mass., Salem—The contract has been awarded for an addition to the factory of W. P. and E. F. Harmon, manufacturer of leather findings.

Mass., Springfield—Morris & Co., Union Stock Yards, Chicago, Plans to construct a cold-storage plant at Springfield. Estimated cost, $15,000.

Mass., Taunton—Plans are being prepared by H. L. Gilman, Arch., 8 Congress St., Boston, for the construction of a 1- and 6-story paper mill and box factory for Taunton Capitalists. Estimated cost, $75,000.

Mass., Ware—The contract has been awarded for the construction of a 1-story, 100x300-ft. factory for the Ideal Coated Paper Co., Brookfield. Estimated cost, $50,000. Noted Mar. 30.

Conn., Danielson—Preliminary plans are being prepared for an addition to the Connecticut Mills Co., 175 Connecticut Mills Ave., manufacturer of cotton fabrics.

Conn., Williamsville—Plans are being considered by the Killingly Manufacturing Co. for the construction of a large yarn mill.

MIDDLE ATLANTIC STATES

N. Y., Johnson—Plans are being prepared for an addition to the plant of the Endicot-Johnson Co.

N. Y., New York—(Borough of Richmond)—American Linoleum Co., 366 5th Ave., Manhattan, has awarded the contract for a 1-story addition to its plant at Linoleumville. Estimated cost, $25,000.

N. J., Butler—An addition will be built to the plant of the Pequanoc Rubber Co.

N. J., Newark—Fire, July 1, damaged the plant of the Clark Mile End Thread Works. Loss, $10,000.

N. J., Rahway—A 3-story addition will be built to the plant of Merck & Co., manufacturer of chemicals.

N. J., Trenton—Plans are being considered by the American Bridge Co. for the enlargement of its boat building works. The company also plans to remove its Berlin plant to Trenton.

N. J., Trenton—A 1-story addition will be built to the plant of the Luzerne Rubber Co. on Muirhead Ave.

Penn., Milton—West Branch Knitting Co. is building an addition to its plant.

Penn., Philadelphia—The contract has been awarded for a 4-story addition to the plant of the Surpass Leather Co., 9th St.

Penn., Philadelphia—An addition will be built to the plant of the Philadelphia Paper Manufacturing Co., Manayunk.

Penn., Philadelphia—The contract has been awarded for a 6-story, 180x200-ft. factory for William R. Warner Co., manufacturer of chemicals. Estimated cost, $300,000. Noted July 6.

Penn., Pittsburgh—Hackmeister-Lind Chemical Co., 1910 Forbes St., plans to construct a 4-story building.

Penn., Reading—Deeds & Staudt Hosiery Co. will install new machinery in its plant.

Md., Baltimore—Plans have been prepared for a 3-story plant for the Standard Guano Co., manufacturer of phosphate. Estimated cost, $100,000.

SOUTHERN STATES

Va., Bristol—Plans are being considered by the Bristol Chemical Works for a factory. J. P. Ray, Damascus, is Pres.

N. C., Kittrell—R. E. and C. B. Barnes plan to construct a hosiery mill.

Fla., Tampa—Press reports state E. Johnson, 30 Church St., New York, N. Y., plans to construct a shipbuilding plant at Tampa.

Ala., Birmingham—Linde Air Products Co., 42nd St. Bldg., New York, N. Y., has had plans prepared for a plant at 10th Ave. and 28th St.

MIDDLE WEST

Ohio, Hamilton—The Swantz Manufacturing Co. will rebuild its cotton felt plant which was recently destroyed by fire.

Ohio, Ironton—Fire, July 7, destroyed the plant of the Standard Slag Co., manufacturer of crushed slag. Will soon rebuild.

Ohio, Lima—The Hester Tire and Rubber Co. manufacturer tires, etc., will construct a 2-story plant.

Ohio, Toledo—The contract has been awarded for a 2-story addition to Kreft's Dry Cleaning Co., 1408 Cherry St. Estimated cost, $6,000.

Ind., Indianapolis—Fire, July 9, destroyed the plant of the Acme Bedding Co., 1511-13 Bates St. Loss, $4,000.

Mich., Detroit—Bids will soon be received for a 3-story addition to the plant of the Ornamental Products Co., manufacturer of carvings.

Mich., Cadillac—Swift & Co. is constructing a packing plant on River St.

Mich., Grand Rapids—Bids have been received for a factory at Ionia Ave. and Cherry St. for the Brown & Sehler Co., manufacturer of carriages, implements, saddles and harnesses. Estimated cost, $45,000. Noted June 8.

Mich., Reed City—The plant of the William Horner Flooring Co., manufacturer of hard-wood flooring, was recently destroyed by fire. Loss, $20,000.

Ill., Chicago—Contract has been awarded for a 4-story packing plant for L. Pfaelzer & Sons. Estimated cost, $10,000. H. McLaren, Arch.

Wis., Sheboygan—George H. Ridell will establish a plant for the manufacture of fiber furniture and similar goods.

WEST OF THE MISSISSIPPI

Iowa, Davenport—The Henry Kehro Packing Co. will build a 4-story cold-storage plant. Clausen & Krause, Central Office Bldg., Davenport, is Arch.

Minn., St. Paul—Foot, Schultze & Co., manufacturer of boots and shoes, has awarded the contract for the construction of a factory on Robert St. Estimated cost, $500,000. Noted Mar. 7.

Neb., Omaha—Armour & Co. has awarded the contract for the construction of a 2-story machine shop.

Mo., Columbia—Plans are being considered by the Hamilton Brown Shoe Co., St. Louis, for the construction of a new factory in Columbia. Estimated cost, $40,000. P. L. Hogan Local Supt.

Tex., Wharton—The contract has been awarded for the construction of a cold-storage plant for the Texas Southern Electric Co.

Colo., Brighton—Great Western Sugar Co. plans to construct a plant at Brighton.

WESTERN STATES

Ariz., Yuma—J. B. Sparks, Imperial, Calif., will construct a cotton gin at Yuma.

Ore., Rainier—N. N. Blumensaadt of the Rainier Land Co. is interested in a project to construct a canning plant.

Calif., Dinuba—Dinuba Grape Growers Association plans to construct a packing plant.

Calif., Fresno—The plant of the Cudahy Packing Co., Santa Fe Ave. and Monterey St., recently destroyed by fire with a loss of $40,000, will be rebuilt.

Calif., Portersville—Tule River Packing House plans to enlarge its plant. H. Wilson is Pres.

CANADA

Que., Quebec—St. Lawrence Paper Bag Co., 103 Marguerite St., is having plans prepared for an addition to its plant. Estimated cost, $20,000.

Ont., Campbellford—The contract has been awarded for the construction of a plant for the Northumberland Paper and Electric Co. Estimated cost, $50,000. Noted Mar. 16.

Ont., London—Plans are being considered by H. S. Hall, 215 Suydam St., Jersey City, N. J., for a glove factory at London.

Ont., Toronto—Plans are being prepared by Heuschilieu & McLaren, Arch., 431 South Dearborn St., Chicago, for a cold-storage plant for W. Davies Co., 521 Front St.